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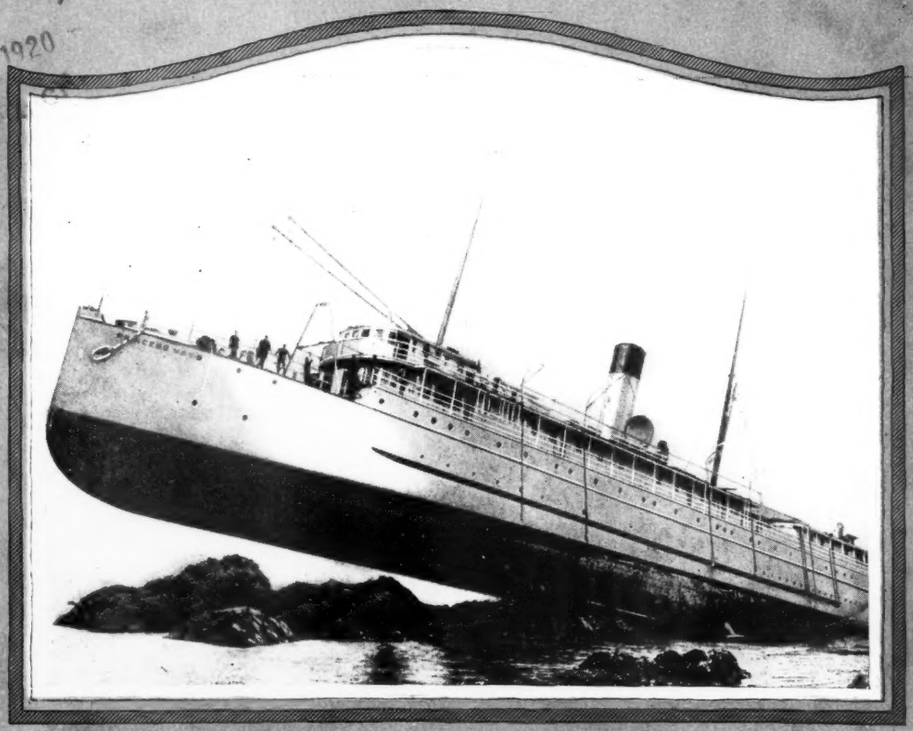

THE "PRINCESS MAY"; A SHIP THAT WAS LOST YET SAVED—SEE LEADING ARTICLE

Modern Marine Salvage and its Potentialities
Robert G. Skerrett

Research Plant for Investigation of the Air Lift
Eugene P. McCrorken

Crude Rubber—Its Production and Uses
Richard Hoadley Tingley

Getting Best Results From Rock Drill Bits
Walter E. Carr

TABLE OF CONTENTS, PAGE 9808—ADVERTISER'S INDEX, PAGE 9811

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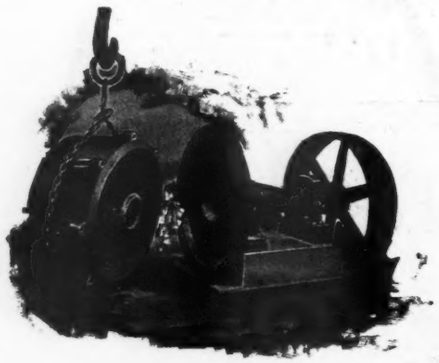

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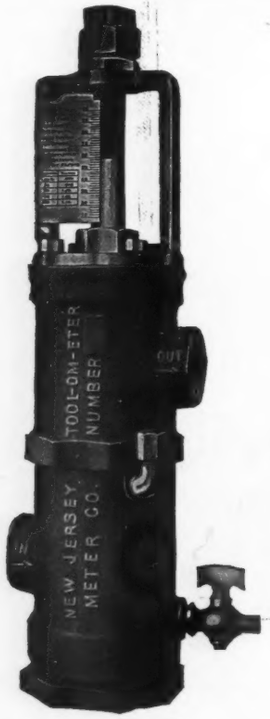

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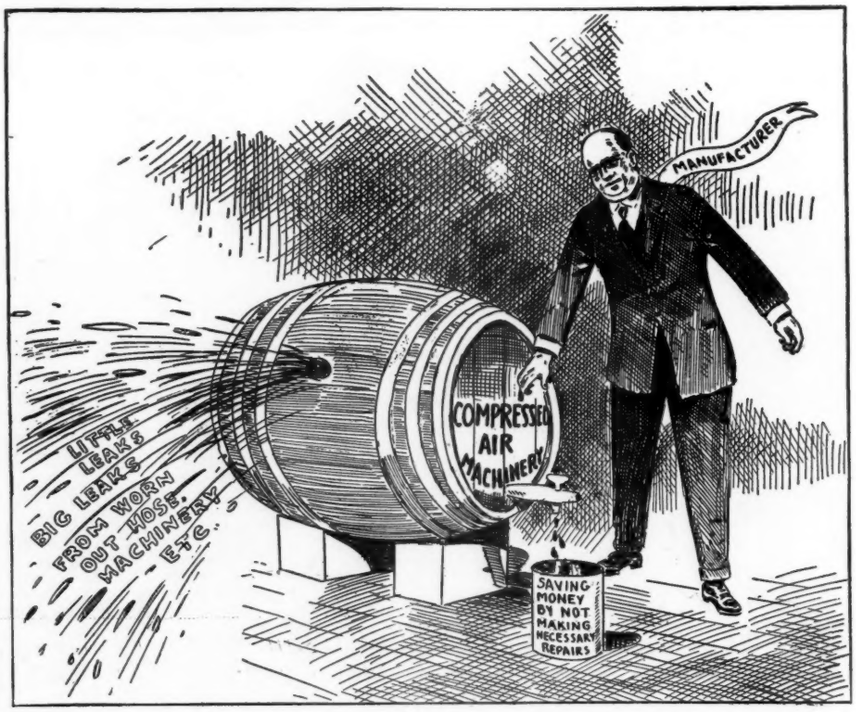

SAVING PENNIES ON REPAIRS—WASTING DOLLARS IN AIR LEAKAGE

The above cartoon reprinted from Compressed Air Magazine; April, 1920, page 9633, shows the plight of any air user who fails to investigate his losses.

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Modern Marine Salvage and its Potentialities

Raising Hundreds of Sunken Ships by Scientific Methods in Which Compressed Air Undoubtedly Will Play a Vital Part Will Develop an Entirely New Industry

By Robert G. Skerrett

THE SALVAGE of sunken ships from now on is likely to be more of a science than hitherto, thanks to the lessons learned and the pooling of technical knowledge during the crucial years of the World War. Prior to that period maritime wrecking, taking it by and large, was all too often lacking in evidences of engineering cunning.

The great majority of vessels salvaged were freed from their predicaments by rather rough and ready methods which had recourse to sheer force, crude carpentry, makeshift tinkering, and dependence upon pumps that were operated commonly at a serious disadvantage. Where these agencies could not bring about a boat's release the wreck was as a rule abandoned by her owners and the underwriters looked to for settlement. No wonder that hundreds of craft were left to batter themselves to pieces or were blown up, if a menace to navigation, instead of being restored to service.

The great conflict aroused the nations battling with the Central Powers to the need of saving injured ships wherever it was possible to do so lest the ubiquitous U-boats succeed in their grim quest to cut off the Entente Allies' vitally necessary oversea lines of communication. Great Britain felt the urge of this with especial force and, therefore, before the struggle was many months old, she called into being the Admiralty Salvage Section. This division of reclamation work was eventually put under the direction of Captain Fred W. Young, a civilian, who had made his mark in doing some rather notable things as an executive of one of England's biggest marine wrecking associations. This course was a wise one.

Before going into details about what was done in handling damaged or wrecked craft in European waters, let us sketch broadly the methods usually employed in floating sunken ships. These are patching and pumping, the construction of cofferdams that raise the flooded boat's body above the surface of the tide, and, in fewer cases, lifting the foundered vessel from the depths by the aid of pontoons supporting wire-hawser loops passing under the submerged hull. These pontoons or "lumps," as the British call them, are virtually floating tanks. For special work, submergible pontoons in the shape of steel cylinders have been used. These, when ballasted, can be sunk close alongside the ship to be raised. At the proper time they are made buoyant by charging them with compressed air—this procedure serving to expel simultaneously their burden of water ballast. The practice is to attach these "camels" to the sunken vessel by suitably secured steel hawsers.

As the records show, maritime losses during the war were, in the order of tonnage affected, due to mines, submarines, and seagoing risks, the ratios being, respectively, 42 per cent, 38 per cent, and nearly sixteen per cent. By far the larger part of the work cut out for the Admiralty Salvage Section lay in getting wounded craft into shallow waters where they could be beached with a likelihood of getting them off again and towing them into port for repairs. This meant placing them in positions that would facilitate the employment of ordinary salvage operations.

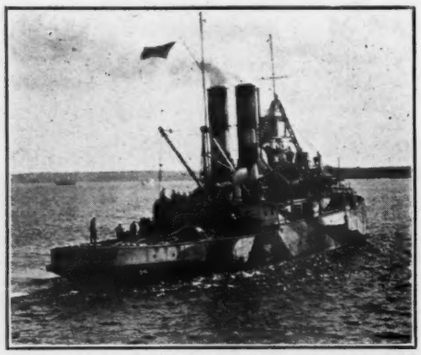
It seems that not more than 20 per cent of the splendid work accomplished by Captain Young and his corps involved the actual raising of ships resting upon the bottom in really deep water. Even so, the results obtained in the latter cases are hearteningly suggestive of what may yet be achieved in recovering hundreds of the vessels that should well repay reclamation and which are not beyond the reach of the properly equipped modern marine wrecker.

Time was essentially of prime importance in dealing with the task cut out for the Admiralty Salvage Section and likewise for our own people who joined in this work in 1918. Captain Young divided the waters about the British Isles into districts, and salvage steamers, manned by qualified complements, were held continually ready in each of these to speed away to stricken boats calling for help in any of these zones. The salvage steamers were mainly recruited from old gunboats which, by the way, were left with enough of their armaments aboard to fight off German submarines seeking to interrupt their activities.

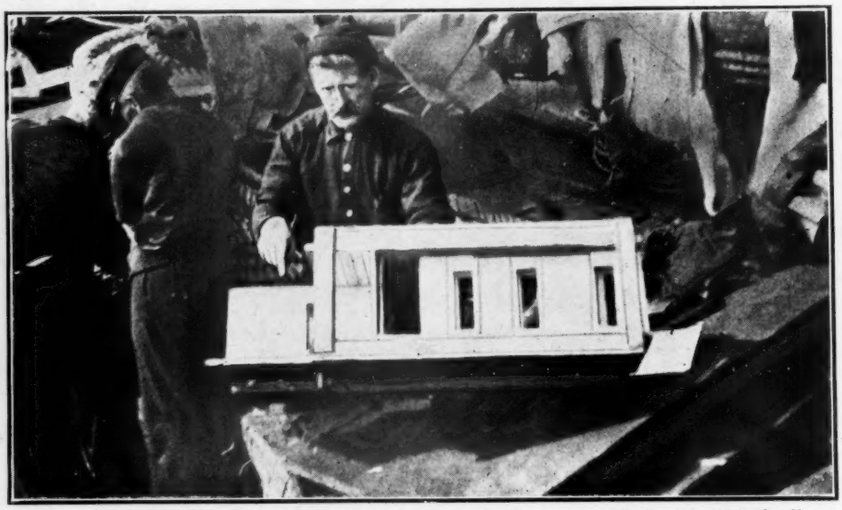
More than once the Kaiser's sea asps levied toll among these wrecking craft, and the erstwhile gunboats had ever to be on the alert against their stealthy foes. The naval rifles were used on a number of occasions to help save injured vessels by sinking them so that the ships might be worth refloating subsequently. This no doubt sounds paradoxical, but a case or two will make the wisdom of this course plain. Naturally, that wartime expedient has little significance in normal salvage undertakings.

In April of 1918, the American tanker *O. B. Jennings,* laden with 16,000 tons of oil, was rammed in the English Channel by a large freighter likewise carrying oil and other inflammable materials. The friction of the impact, besides tearing a great hole in the side of the Jennings, set her afire. The boats dispatched to the scene found it impossible to smother the blaze. In order, therefore, to prevent her destruction and the total loss of her cargo of precious fuel, she was shelled and sent to the bottom in water of moderate depth. Afterwards, her collision-rent plating and the projectile holes were sealed by divers, and the tanker raised and towed into port. Having been temporarily repaired she started back to the United States, but was attacked and sunk by a U-boat when off the coast of Virginia.

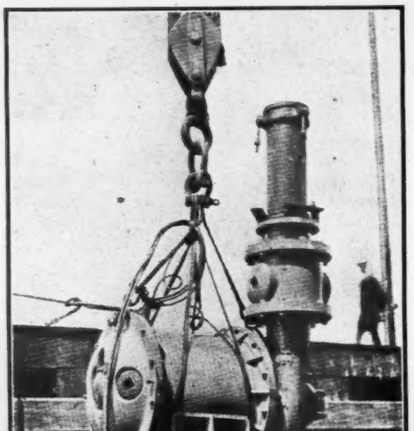
The freighter that hit the Jennings suffered even more grievously. She, too, took fire, and the explosions that followed killed nearly all of her crew. The salvors stuck to their tasks, however. They managed to get hawsers secured to the flaming ship, and then towed her stern first against the wind, hoping



The U. S. salvage "Favorite," equipped with powerful compressors.



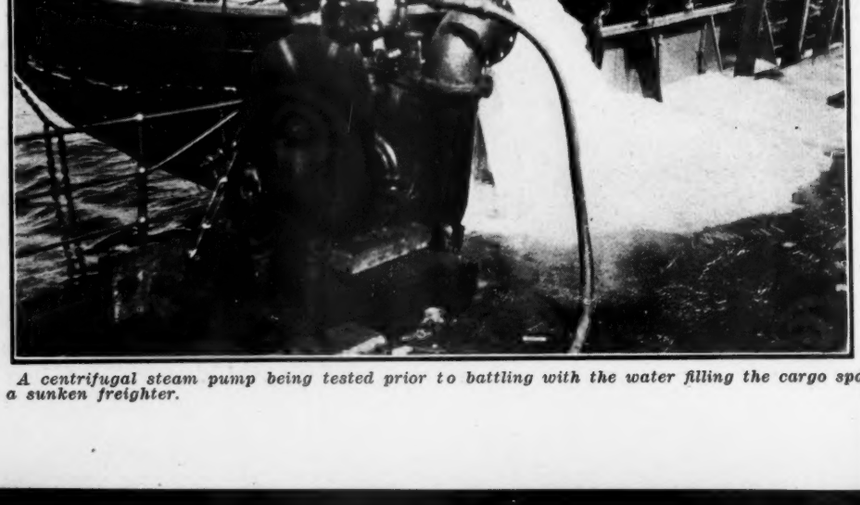
The card-board model of the passages within the S. S. "Empress of Ireland" which the divers had to thread in reaching the purser's office and the strongroom. The men were obliged to thoroughly familiarize themselves in this way with the path they had to follow to reach the mail and treasure aboard.



An eight-inch electric submergible pump capable of lifting 400 tons of water an hour.

Some of the $3,500,000 worth of silver bullion recovered from the strongroom of an Oriental liner sunk deep in the English Channel.

The diver is indispensable to marine salvage.



A centrifugal steam pump being tested prior to battling with the water filling the cargo space of a sunken freighter.

by doing so to check the spread of the conflagration. After nine hours of desperately hard work, the big merchantman stumbled upon a mine which burst under her, tearing a hole in her bottom and parting one of the cables. A few seconds later two other mines caught her aft. Try as hard as they might, the men of the salvage flotilla could not get other lines to her. Being close to an inlet on the south coast of England, a salvo or two of rapid-fire shells sank her where she could be recovered a while later.

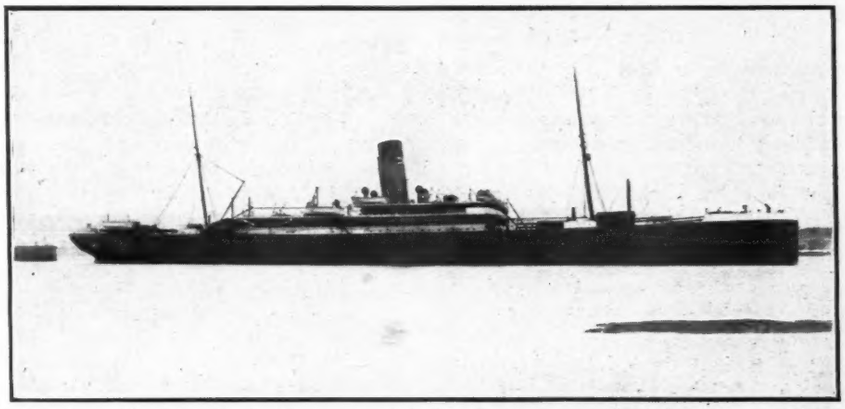
As the purpose of this article is to point out the marine salvage lessons of the war and to deduce from these the likelihood of the extensive refloating of fine ships or the recovery of their valuable cargoes, it is essential that we limit ourselves for the most part to exploits that have a potential bearing upon future marine wrecking undertakings. The whole subject must be considered upon a peacetime commercial basis and not as the outcome of valiant and desperate efforts to offset at any cost the ravages of hidden mines or any blows of torpedoes launched from concealed U-boats. Accordingly, let us see how the exceptionally difficult cases were handled.

A big steamer, carrying $15,000,000 worth of foodstuffs, was torpedoed after entering British home waters, and, despite all the rescue flotilla could do, she sank rather deeply off shore. From her keel to her shelter deck she measured 57 feet; and this deck was above the sea for only an interval of two hours at low tide. The wound that had caused her to founder was 40 feet long and 28 feet wide; and before the war a ship so circumstanced would have been classed a hopeless wreck. Even so, the Admiralty salvors reclaimed her.

First, divers were sent into the steamer—men thoroughly familiar with the hazardous work of threading their way through the black and slimy intricacies of submerged craft; and these toilers drilled and blasted holes through intervening bulkheads until they came to the stokehold, which was to serve as a sump for water draining aft from the compartments ahead. Down into the inky inundated depths of the fireroom were lowered a number of pumps, with their discharge pipes leading up above the surface of the tide, but these pumps were of a sort not familiar to American salvors.

The lift pump ordinarily employed in wrecking undertakings is driven by steam and stands above the surface when in action. It is able to raise water to a height of about 28 feet. The submergible pump, on the other hand, is electrically propelled, can force upward to a height of 80 feet hundreds of tons of water hourly, and may be dropped far down into the flooded bowels of a boat. The motive current is supplied by an armored cable transmitting energy from a generating plant aboard a salvage craft, and the vitalizing link can be disconnected or quickly and just as easily picked up afterwards if the work be interrupted by stormy weather. All the while the submergible pump lies snugly within the sunken ship and out of the way of the sweep of violent and possibly destructive seas. This is quite different from the situation of the usual

An impressive group of 40 American divers—the largest number of under-water workers ever simultaneously employed on a single wreck.



The steamship "Bavarian." She was sunk in the St. Lawrence about fourteen years ago and was the first big vessel to be raised by means of compressed air internally applied. Americans did the work.

How the deformed bow and smashed plating of the S. S. "Uranium" looked when that steamship was drydocked in New York.

lift pump which is necessarily exposed upon the deck of the wrecked vessel.

But before the food-laden freighter could be lightened by means of the submergible electric pumps it was necessary to close the great gap in her side so that she would, in effect, be like a filled bottle with the neck projecting above the surface when the shelter deck rose clear at low tide. The wound was sealed by covering it with a so-called "standard patch." The standard patch used by the Admiralty salvors was made of six-inch planking, reinforced by steel straps, and modeled so as to fit snugly against the outer skin of the ship. Upon many occasions the form of this patch was determined by measurements taken by divers, and, of course, its shape varied agreeably to the part of the hull to be dealt with.

When ready, the patch was lowered directly alongside the rent and guided into place by under-water workers—other divers inside of the vessel secured nuts over screw bolts, attached to the patch, as these bolts penetrated inward through holes previously drilled in the sound shell plating around the injured area. When sufficiently drained by the submerged pumps, the merchantman concerned was towed into shallower water where she was permitted to ground again. There the salvors were able to remove from her thousands of tons of commodities that were unharmed by submergence.

Something like fifteen years or so ago, Captain Young had charge of the recovery of the *Sarah Brough,* a small steamer which was sunk off Holyhead in twelve and a half fathoms of water. Four wire hawsers were passed under her and were hove taut at low tide to two pontoons, and the buoyancy of the latter sufficed to elevate her a few feet clear of the seabed with the incoming flood. In this way, a total deadweight of 370 tons was lifted and the little craft was moved five miles inshore where she was beached and afterwards pumped out, towed to Liverpool, and made fit again for service. At that time the raising of the *Sarah Brough* was a record performance, and from the experience gained in her case a vessel of 1600 tons, completely submerged, was similarly salvaged a while before the war.

Under Captain Young's direction, a laden collier, representing 2500 tons submerged, was lifted by pontoons and steel cables from a depth of 72 feet—the wreck being sustained by sixteen nine-inch lines. The load was lightened by forcing compressed air into the collier's ballast tanks, and thus driving the sea water out of them. Last year the Admiralty Salvage Section raised in the same manner a ship of 3800 tons deadweight from a depth of 23 fathoms, i. e., 138 feet. Nothing paralleling this has been done elsewhere to date; and the achievement has the utmost significance. It indicates that many difficulties were overcome that were supposed to make the salvage of really big craft in a kindred predicament quite out of the question.

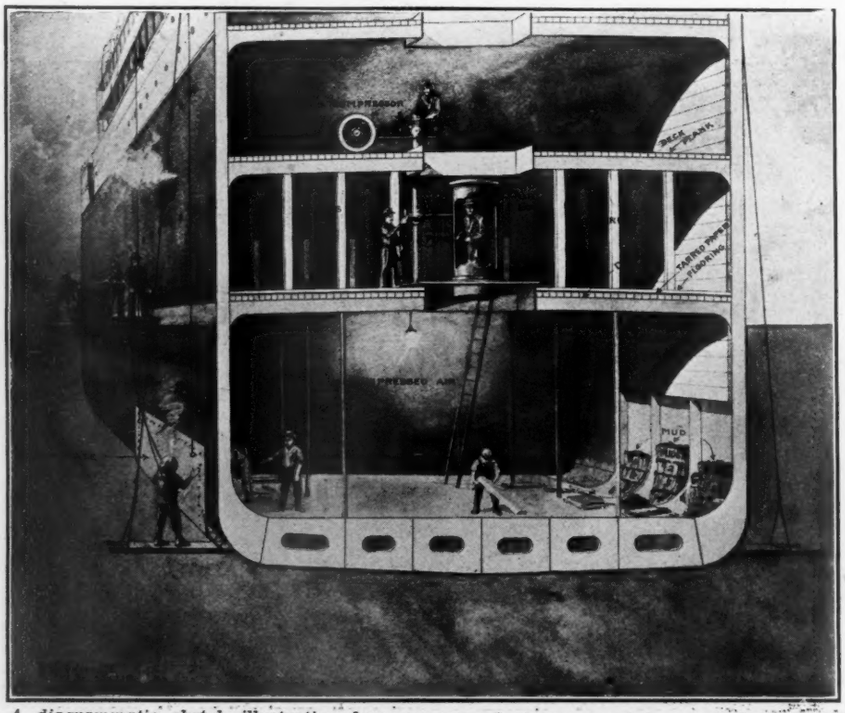
It should be remembered that the steel cables must be strong enough to withstand intermittent stresses of 200 tons and more on each of them, and these, in the form of slings, must be distributed along the bottom of a vessel so that they will severally sustain their share of the burden without concentrating to a dangerous extent the load upon any one of them—otherwise, the wire ropes would be apt to deform the ship's backbone and tear right through the shell plating. It would be hopeless then to effect recovery of the boat in a condition permitting profitable repair.

It is not enough to get the hawsers properly in place beneath a submerged ship—it is equally essential that the pull on these lines shall be uniform and not subject to violent jerking through the action of the pontoons when exposed to a seaway. Needless to say, this means that the sunken wreck can generally be dealt with only when the water is fairly smooth, and, even then, if the submerged ship is suspended upon the slings, the pontoons must not be rigidly tied to the supporting cables. In short, a measure of give and take is essential.

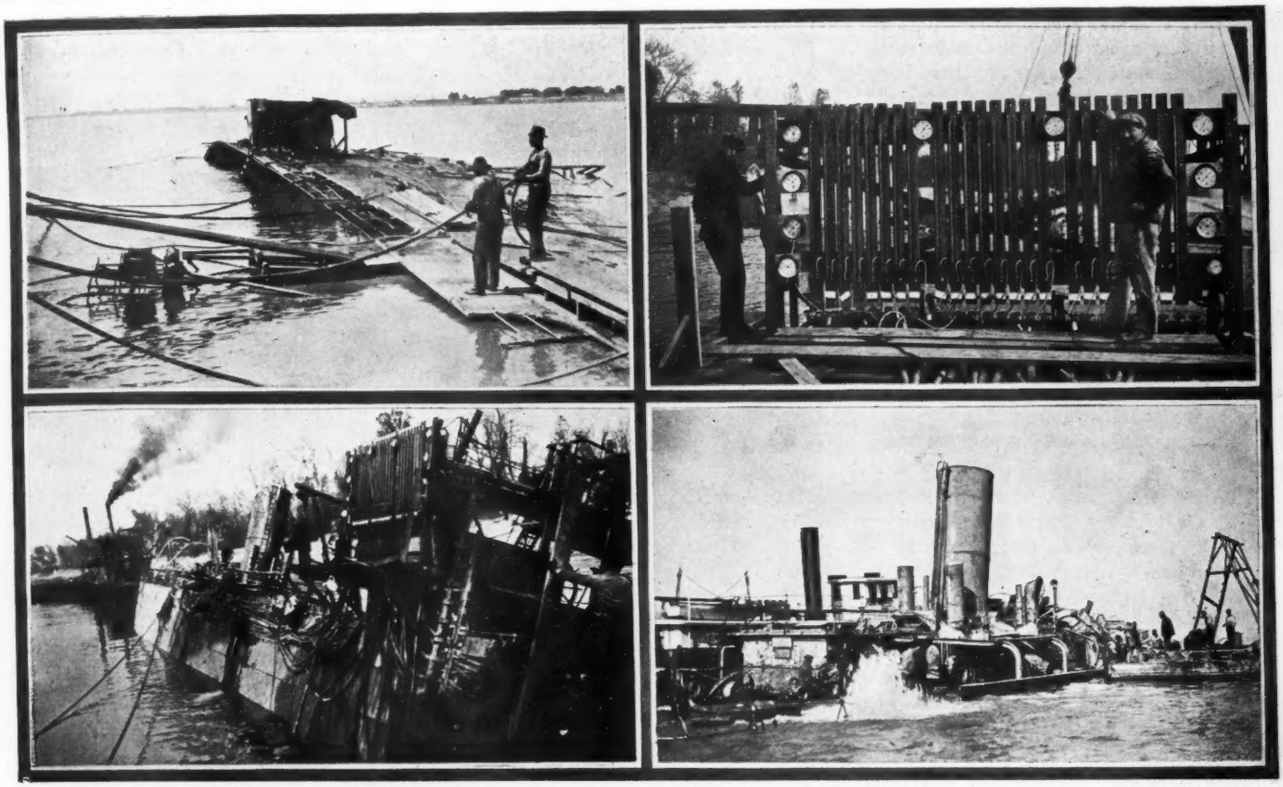
Lowering an air lock into position on the submerged deck of the U. S. Cruiser "Yankee."

The British salvors obtained this necessary elasticity by an ingenious adaptation of the well-known Bullivant cable clamp, which was so arranged that it would grip under a steady load and yet yield to a sudden pull. Clamps of this sort were interposed between powerful winches and the deadweight on the hawsers—the winches instantly recovering slack and the clamps giving whenever a seaway tended to make the pontoons roll and jerk to a troublesome extent. Thus, by ceaseless vigilance on the part of the men at the hoisting machine, it was found practicable to keep the tension on the various hawsers steady enough to enable the wreckers to lift the foundered vessels, without hurting them, at each tide and to carry them, stage by stage, nearer shallower water and into sheltered areas where the more common salvage methods could be used in refloating the boats.

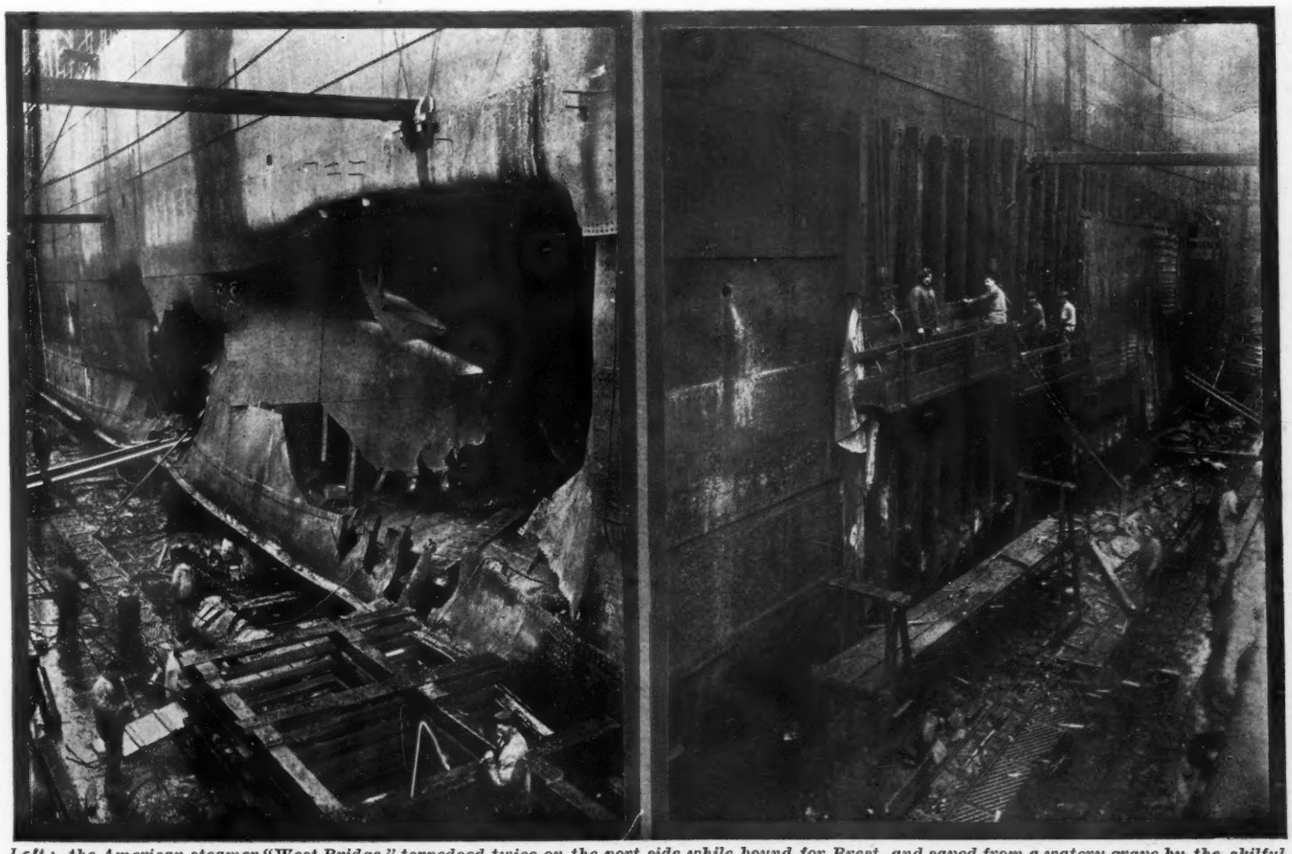
Undoubtedly, the most spectacular work of the salvage section, judged by the human interest factor, was that in connection with the recovery of the big British submarine K-13, which sank while on a trial trip with 90 persons aboard. The commander of a surface craft observed the manner in which the steam-driven submersible went under and was so worried by the subsequent appearance of air bubbles in large quantities that he summoned on his own initiative a number of salvage boats—being convinced that something was wrong.



A diagrammatic sketch illustrating how compressed air was used to expel the water from the floated cargo spaces of the S. S. "Royal George." After blocking the holes in the hull with pudge boards, compressed air enabled the wreckers to cover the rents with patch plates secured.



Upper left; the tanker "Gut Heil" as she lay overturned and sunk in the Mississippi River before the salvors started to right her and to bring her back to an even keel. Upper right; the wrecking masters' station showing the arrangement of gauges which advised him of the condition in every part of the sunken craft. The numerous valves enabled him to regulate to a nicety the buoyancy of every flooded space. Lower left; the craft in a partially raised condition showing the wrecking masters' station and the pipes leading to various compartments from which he expelled or admitted water at will, thanks to the service of compressed air. Lower right; the "Gut Heil" resting upright and acquiring buoyancy by virtue of compressed air forced into her compartments.

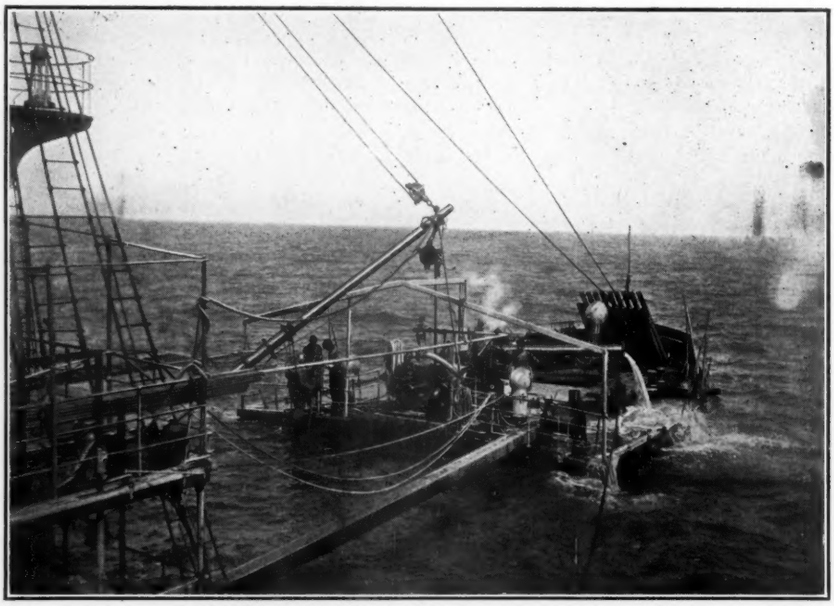


Left; the American steamer "West Bridge," torpedoed twice on the port side while bound for Brest, and saved from a watery grave by the skilful work of our own salvage corps stationed in European waters. Right; the great patch applied by our salvors over the two holes in the submerged side of the S. S. "West Bridge." This patch is typical of the flexible method developed by our experts to meet varying conditions and to permit of rapid rescue work.

Divers were sent down in the wake of the escaping air and soon found the submarine lying at the bottom of the bay with part of her after body fairly deep in the mud. Hammer blows upon the hull were answered by the survivors in the forward compartment. It is no part of our story to dwell upon the harrowing experiences of those imprisoned men as the air available for breathing became increasingly foul. Finally, after a day and a half of physical distress and anguish, one of the officers aboard succeeded in getting out of the submarine by juggling compressed air and by using the conning tower as an escape lock. A brother officer died in making a similar attempt.

In this way the salvors were familiarized with the situation and advised how to go about rescuing the people still alive within the K-13. A connection was made through the deck of the boat so that fresh air could first be forced into the stricken craft to revitalize the atmosphere and then to charge some of the flasks until the stored pressure rose to 2500 pounds. With this medium of control renewed, it was possible to blow out a number of the forward ballast tanks—this buoyancy serving to bring the bow of the K-13 higher and higher until at last her head mounted above the surface a distance of ten feet. By means of another connection leading into the occupied compartment, milk and chocolate and brandy were successively sent down to the well-nigh exhausted men in the submersible, and these served to revive them though their predicament was still a grave one.

The next thing the salvors did was to pump out the water confined between the superstructure forward and the main hull. After this, by means of oxy-acetylene torches, a square eighteen-inch hole was cut through the two walls of steel and a passage cleared by which the feeble but rejoicing 45 survivors could be lifted up into the sunshine. Subsequently the K-13, with the fatal open ventilators closed, was lightened by means of compressed air, which drove the seawater out of her after section. In this manner she was raised and then towed into a neighboring drydock. The very nature of the submersible's structural getup made it quite feasible to fill her with compressed air without inviting bursting pressures. A surface craft, similarly circumstanced, could not be refloated without considerable strengthening of the hull and much preparatory work on the part of divers. Even so, we shall learn presently of some very remarkable salvage work made possible by compressed air applied variously in salvaging sunken ships.

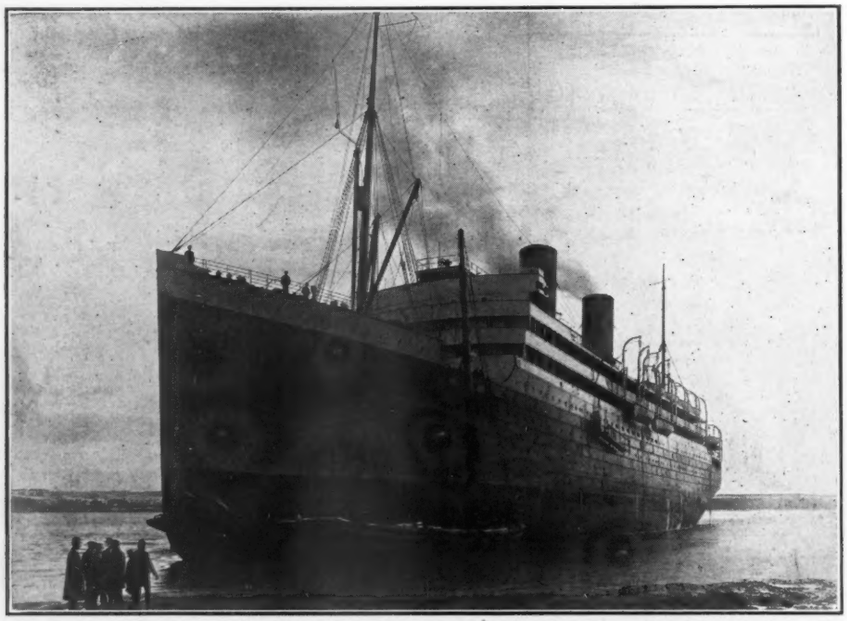


This gunboat, sunk by Mexican revolutionists, lay out in the open sweep of the Gulf of Campeche. The salvors had to close a large rent by a bomb, seal all other submerged openings, and build a water-tight cofferdam before the vessel could be pumped out and raised.

Out of the nearly 13,000,000 tons of shipping sent to the bottom or wrecked during the period of the war only a relatively small percentage has been recovered up to date. The Admiralty Salvage Section has to its credit the refloating of about 450 vessels—a splendid performance unquestionably, but involving just a few of the vast array of craft that can be raised if the work be prosecuted with all of the technical knowledge and the special apparatus now available. The biggest lifting problem at present engaging the attention of the British naval wreckers is that represented in clearing away the block ships sunk at Zeebrugge. Each of these has a deadweight of about 5000 tons and therefore is considerably heavier than any craft previously recovered by the use of steel cables and surface pontoons.

But don't let us imagine that Captain Young and his force were the only wreckers bent upon neutralizing the destructive activities of the Germans. In 1918, we organized a ship salvage corps under the direction of the Chief Constructor of our Navy, and we recruited it mainly from civilians widely experienced in marine reclamation. We sent a considerable body of this highly qualified force to Europe in response to the urgent request of Vice-Admiral W. S. Sims, and we equipped six or more vessels for the service. These salvage steamers were provided with the latest thing in hospital locks, powerful compressors, big air tanks, portable compressors and pumping units, the sturdiest of "beach gear,"oxy-acetylene outfits, etc. While this flotilla arrived too late to participate in the feverish work of reclamation provoked by Teuton submarines, still our men did their bit and were instrumental in introducing innovations of a very suggestive nature. Indeed, they were able to teach fully as much as they could learn from association abroad; and it is largely upon the past performances of our people that we can predict confidently an amazing future for the maritime wrecker.

Americans have only a hazy conception of what its salvage experts have done heretofore in relieving and refloating ships that seemed doomed, judged by the prevailing



The S. S. "Royal George" at low tide showing how the ship was piled high on the rocks of the St. Lawrence. Compressed air got the steamer afloat and also enabled the salvors to repair her ruptured bottom so that she could proceed to sea without drydocking.

standards of the commercial salvor. They have accomplished the well-nigh impossible by breaking away from traditional processes and utilizing the singularly flexible and potent agency of compressed air. Let us sketch as briefly as we can some of the outstanding achievements that show how we have blazed the way.

In November of 1912, the steamship *Royal George* of 14,000 tons ran on the rocks in the St. Lawrence while speeding along in the fog at about twenty knots an hour. Boulders ripped great rents in her bottom plating, both gripping her and flooding her cargo spaces, etc. Despite the strenuous efforts of numerous tugs and several large steamers, the salvors could not pull her free at high tide; neither could an array of wrecking pumps lighten her. The underwriters imposed an almost prohibitive rate for her insurance; and winter was approaching with the likelihood of gathering ice crushing the ship's hull hopelessly. A New York salvage expert was summoned. Under his guidance, hatches were sealed, decks reinforced, and air-locks installed so that the flooded spaces could be charged with compressed air and the invading water driven out through the very holes which had admitted it.

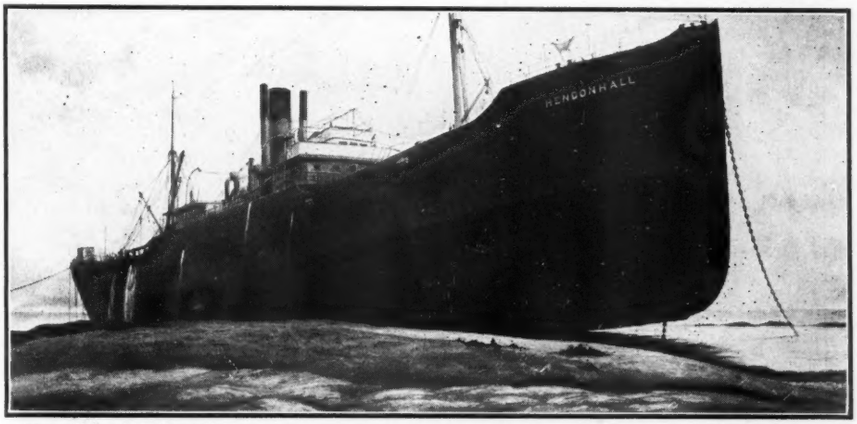
With the compartments drained, "sand hogs" were able to go into the holds and temporarily close the rents by means of pudge boards and clay. Patch plates were made and lowered into place as indicated by one of the illustrations. The *Royal George* thus became her own drydock; and within six days was repaired, where she floated, so that she could proceed to sea—taking on a profitable cargo of lumber at Halifax.

The *S. S. Uranium* ran hard upon the stony ledge of Chebucto Head, near Halifax, in January of 1913, smashing her bow and bottom plating forward. She was floated off and convoyed into Halifax five days later, but there was no drydock available for her immediate admission and repair. Again, compressed air saved the day. Within the damaged compartment, over the disrupted steel work were laid blankets of sheet lead which readily conformed to the broken contours. Upon the lead was spread a mattress of concrete to give stiffness, and then compressed air was forced into that cargo space. This invisible medium held the lead and cement firmly in place, kept the water out, and permitted the *Uranium* to steam against head seas on to the port of New York, where she was drydocked and her injuries taken care of.

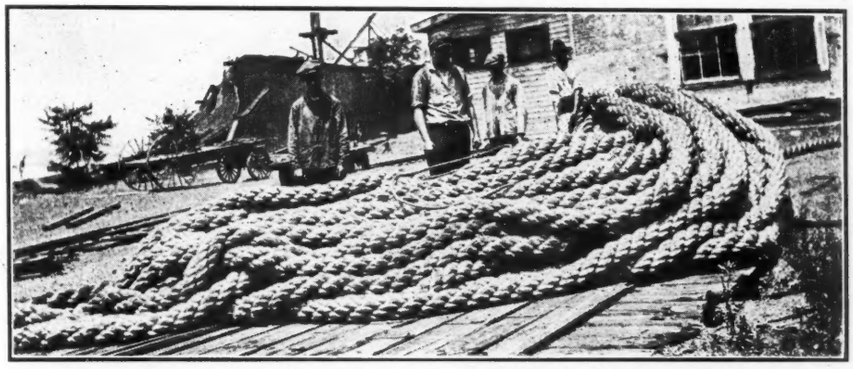
Early in November of 1914, the liner *Zeeland*, a ship of 12,000 tons, went ashore in the St. Lawrence during thick weather. She struck the mud so hard that she was lifted about three feet above her light load line. She had very little cargo aboard which could be removed to help towards refloating her. The wreckers decided that the quickest way to get her back into deep water would be to dredge the mud away on either side so that she could be forcibly dragged rearward into the regular channel. But the dredges could not remove the mound of mud directly beneath her; and the working of her engines and the powerful pull on wire hawsers failed to dislodge her. Once more compressed air solved the problem.

Fourteen of the steamer's composition drainage plugs, set in her bottom plating for clearing the bilges when drydocked, were skillfully withdrawn and into the holes were quickly screwed rubber hose connections linked up with an air compressor. When ten seagoing tugs, pulling in tandem, were doing their utmost, and the *Zeeland's* propellers were churning sternward, then a flood of air was blown outward through the fourteen openings between the steel skin and the gripping mud. Inside of ten minutes these bubbles served to break the hydrostatic seal so that the liner could be towed out into the fairway.

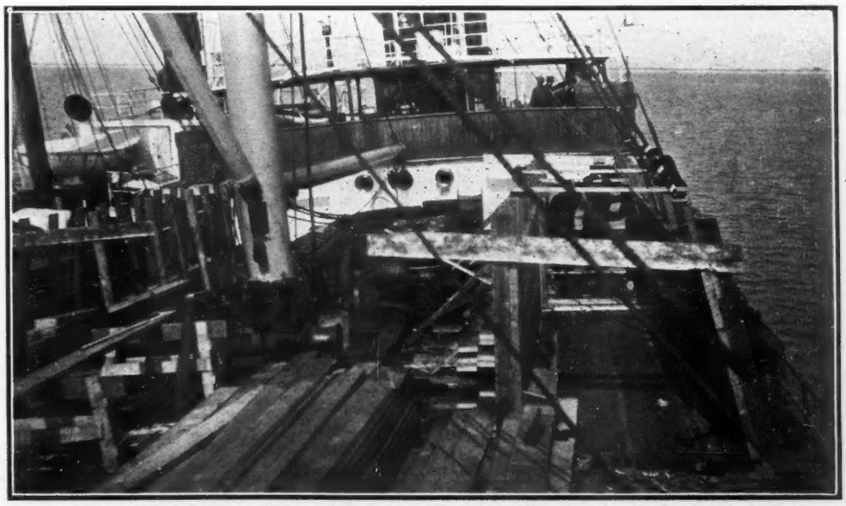
Shortly after the beginning of the World War the *S. S. Floriston* sailed from Quebec bound for England with a cargo of grain amounting to 4,000 tons, and was loaded considerably deeper than her Plimsoll mark because of the urgent demand for foodstuffs. When off Newfoundland she struck an iceberg and was beached on the rocky bottom to save



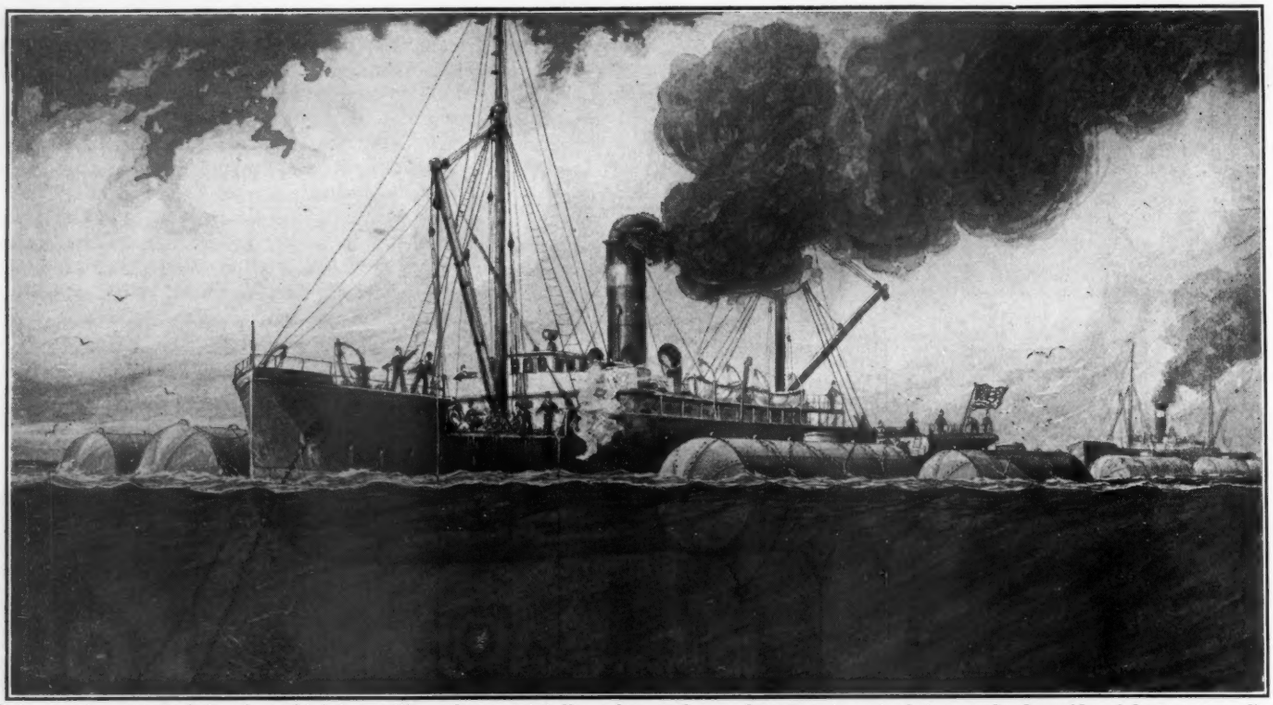
The S. S. "Hendonhall" as she was left at low tide. Compressed air forced the water out of her damaged holds and, while thus keeping the sea at bay she was freed from the rocks and carried to port.



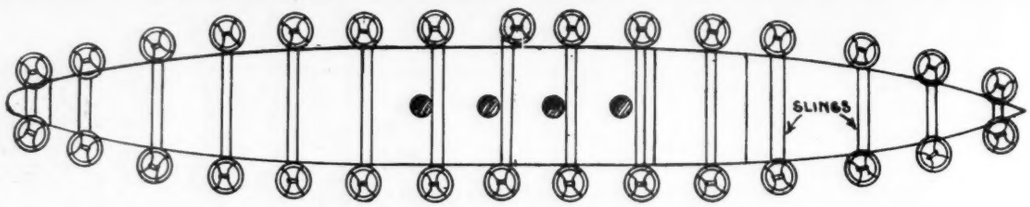
A fourteen-inch hempen wrecking hawser. A sample of the "beach gear" often used in pulling a stranded ship off into deep water.



Even with a shifted cargo the wreckers ran the S. S. "Berlin" on the last leg of her voyage by building compensating tanks on her deck so as to bring her to an even keel by means of water ballast.



Submerged pontoons being brought into position above a totally submerged vessel preparatory to being sunk alongside of her as a preliminary to lifting the foundered craft from the waterbed. Later on they will be filled with compressed air and thus made buoyant enough to exert the necessary lift.



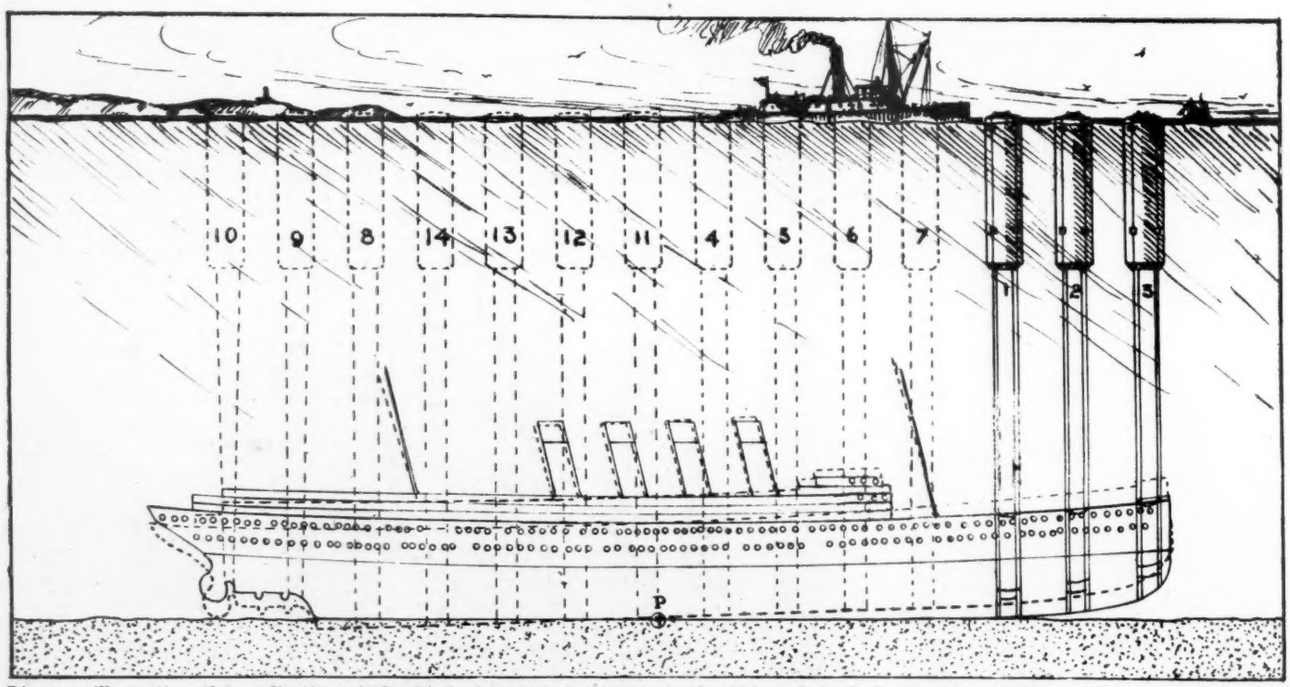


Diagram illustrating the application of the Lindquist vertical pontoons to the lifting of the S. S. "Lusitania." The pontoons are numbered in the order in which they would probably be placed about the ship. The dotted contour of the liner indicates how her bow would be first lifted to permit additional cables being placed beneath her keel—the pivot point, P, being the center upon which this preparatory shifting would be effected. With the hawsers of pontoons one to seven in position, then the bow would be permitted to settle and the cables for the after pontoons would be worked successively beneath the keel. Finally, with all of the lines secured, water ballast would be expelled from the pontoons and their combined buoyancy, carefully distributed, would lift the craft clear of the bottom and permit her to be towed shoreward until she grounded. By shortening the cables at this stage—the pontoons being submerged for the purpose, it would be practicable to effect another lift by discharging their water ballast. This operation would be repeated as often as necessary to bring the vessel up to the surface where ordinary salvage methods would be able to refloat her.

her from a watery grave. Even so, she was looked upon as a total loss.

Recourse was had to compressed air under the supervision of W. W. Wotherspoon, who has led in this sort of salvage, and the craft was gotten clear of the rocks and moved under her own power to Quebec some hundreds of miles away. The compressed air, as will be realized, served to expel the invading water from the flooded area by driving it out through the gaps in the torn bottom plating; and by maintaining this balancing pressure the water was held at bay until the vessel made her distant port.

The story of the *S. S. Hendonhall* is much like that of the steamship *Floriston* except that the *Hendonhall* had no 'tween decks, and the task was therefore made more difficult in order to strengthen the upper deck and to seal her large cargo hatches prior to filling some of her holds with compressed air. The use of tie-rods, anchor plates, and skillfully applied concrete furnished the needful support; and, thus reinforced and made ready, the ship was floated off at practically her builder's light draft and reclaimed after nine months of exposure to more or less violent storms.

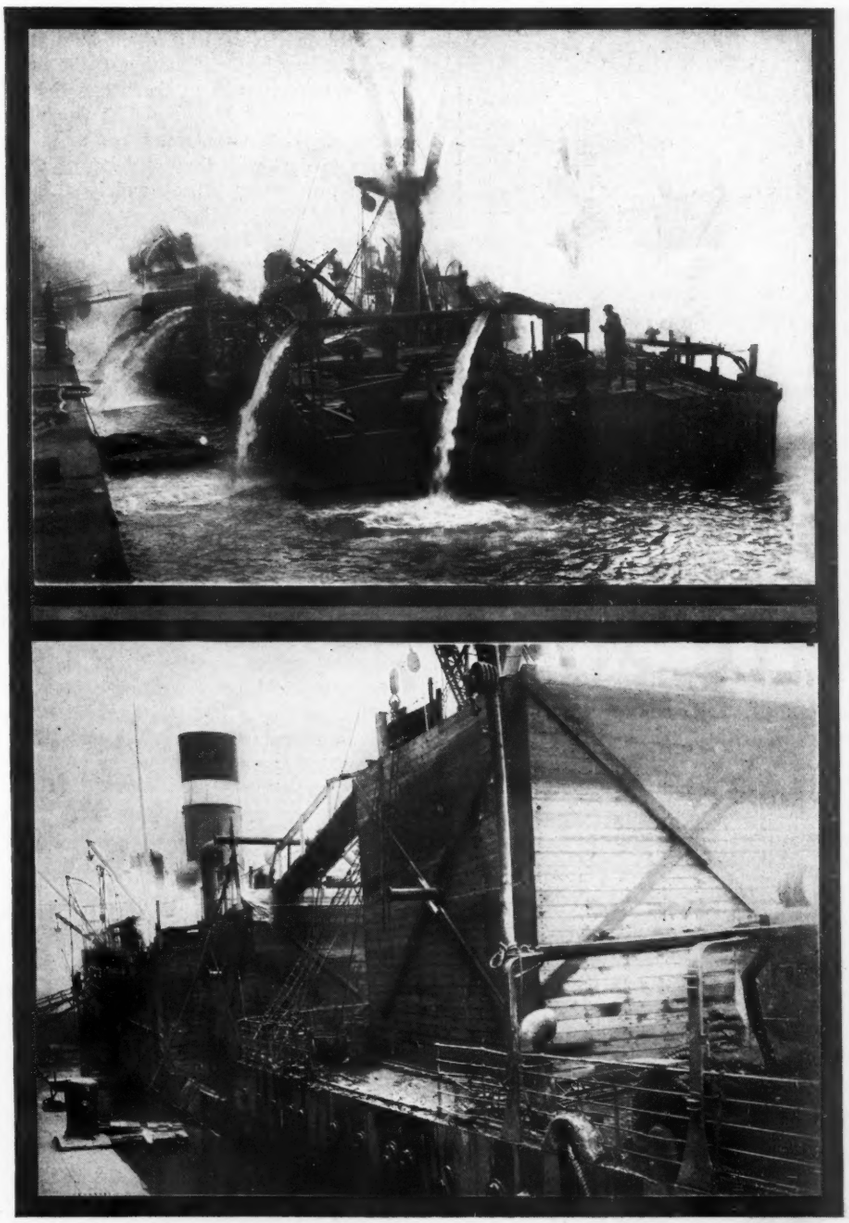
The *Empress of Ireland* was rammed and sunk by the *Storstad,* in the St. Lawrence in the spring of 1914, and the liner carried down to her watery grave a large number of her passengers, considerable bullion, and a quantity of postal matter. She settled in the mud at a depth of 160 feet with her port side uppermost at a sharp angle. The salvors' job was to get into the purser's office, the mail room, and the strongroom where the bullion was stored. To do this, the divers had first to locate a particular position on the port side. This involved hazardous and painstaking searching in the frigid and intense gloom of the depths of the St. Lawrence. With the proper point determined by a certain air port at the end of an athwartship passage, it was necessary for the under-water workers to cut a large hole through the hull plating. This they did by means of submarine pneumatic drills; but there were other things to be done before these men were permitted to do any salvaging.

Flanking doorways were sealed and bulkheads built in the flooded ship for the purpose of closing off passages that might lead the divers astray and imperil their lives. Next, these men were familiarized with the route in and out of the sunken steamer by means of a cardboard model; and they were not allowed to essay the removal of the purser's safe, the mail bags, and the specie, until they could tell with their eyes shut just which way they would have to go if placed anywhere along the course to be followed inside the *Empress of Ireland.* Their success depended upon the preliminary and the precautionary measures taken; and what they accomplished is evidenced of what may again be done in getting into deeply submerged craft to reclaim valuables of any sort.

The recovery of $5,000,000 in gold bullion, carried down by the *Laurentic* when she struck a mine off the north coast of Ireland, was a less expert task than that put through in the case of the *Empress of Ireland.* To reach their goal, the divers blasted away the decks and intervening structure lying above the *Laurentic's* strongroom, and the men were, therefore, able to go more directly and with less risk to their objective when once a path was broken clear for them.

Beyond question, the cleverest thing yet accomplished in the realm of marine salvage was that of raising and righting the big oil tanker *Gut Heil,* sunk in the Mississippi about half a mile below Baton Rouge. She was carried to the bottom, when laden and outward bound, by holes torn in her side after colliding with two other vessels. More than $125,000 had been spent vainly in trying to refloat her, and then a New York salvage specialist undertook to roll her back upon an even keel and to lift her from her muddy grave by compressed air applied inside the steamer.

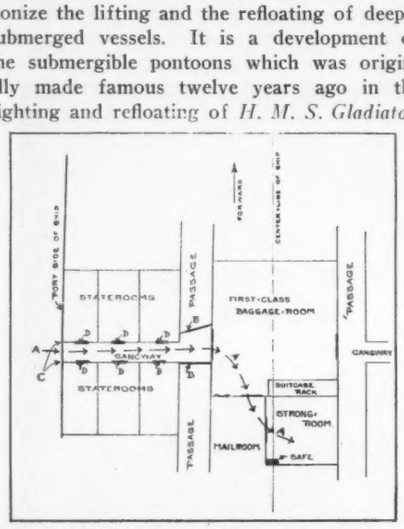
The *Gut Heil* represented a deadweight of about 6,000 tons. At the start, it was necessary to get rid of 4,000 tons of mud which had oozed into her during the years of her submergence. For this purpose, a compressed-air siphon was built, which sucked out the mud and lifted it to the surface where it could be swept away by the river's eddying current. Into each flooded subdivision of the vessel was led a hose to carry compressd air, and other pipes were fitted to these compartments or tanks to carry off the water as it was forced out by the incoming air. The numerous air hose were focussed at a "central" mounted on the upturned side of the *Gut Heil,* and were there connected to a corresponding number of valves arranged on this self-adjusting platform.



Upper; to put out a fire aboard the S. S. "City of Lahore" she was flooded and sunk. To raise her it was necessary to build two big cofferdams about her cargo hatches and to rear these structures above the surface of the water at high tide. Then, through these bottle necks, so to speak, the inundated interior was drained by salvage pumps. Lower; the S. S. "City of Lahore" when nearly afloat. The picture gives a comprehensive idea of the magnitude of the two great cofferdams reared upon her deck.

This was the wrecking master's station. Standing before him was a double system of gauges—one set telling him how much buoyancy or water was in each submerged compartment, and the other set indicating the quantity of operative air at his disposal in the pressure flasks. With these facilities at his command, the salvage master was able to juggle both buoyancy and water ballast with such nicety that he could bring the tanker slowly upright and thus prevent her from acquiring an angular velocity which might have swept her over and caused her to fill and sink with her other side under.

And now we come to a method of using compressed air which may radically revolutionize the lifting and the refloating of deeply submerged vessels. It is a development of the submergible pontoons which was originally made famous twelve years ago in the righting and refloating of *H. M. S. Gladiator.*



Plan of that portion of the upper deck of the "Empress of Ireland" immediately adjacent to the strong room and leading to that point where the hull was cut to effect an entrance.
C, large hole cut in steel side of ship.
AAA, path from the outside inward to the strong room and the return route by which the postal matter, the silver bullion, and the safe were removed.
LV and DDD, bulkheads by which flanking doorways and the longitudinal passage were blocked in order to straighten the route for the divers and to keep them from going astray or becoming confused in entering or leaving the interior of the sunken liner.

The submergible pontoons then employed were steel cylinders twelve feet in diameter and varying in length from 40 to 75 feet. One objection to pontoons of this sort is that they are placed with their longitudinal axis parallel to the ship, and this necessarily limits the number that can be grouped around a wreck, besides restricting the measure of buoyancy that can be brought into play. Further, the horizontal pontoon is difficult to manage in a seaway, and its load is applied vertically, as a bending moment, and, therefore, in the direction in which it is least capable of resisting strain.

Finally, where the submergible pontoon has any considerable length it must sustain the pull of two or more cables passing under the sunken boat; and, when the waves are running, these lines jerk separately and set up dangerous crushing forces which tend to wrack and, perhaps, rupture the buoyant cylinders. It should be evident that submergible pontoons of this character can be used to advantage only when weather conditions and local circumstances favor their employment.

To-day, thanks to the inventiveness of an American, Carl J. Lindquist, we have the semi-submergible vertical pontoon. Broadly speaking, this is the submergible pontoon of the past stood on end, when in action, and provided with operative features that put it in a new and extremely promising class of salvage apparatus. By using his pontoons upright, the structures virtually became floating columns sustaining a compressive rather than a bending stress and, accordingly, are capable of carrying a maximum load without overtaxing their strength.

The four cables are attached to each vertical pontoon and these pass around sliding bits mounted upon its deck, which is always above water. This ingenious arrangement enables the pontoon, through its upward thrust, to equalize the tension on the hawsers—thus continually maintaining a uniform distribution of the load on each and all of the lines, no matter what may be the condition of the sea.

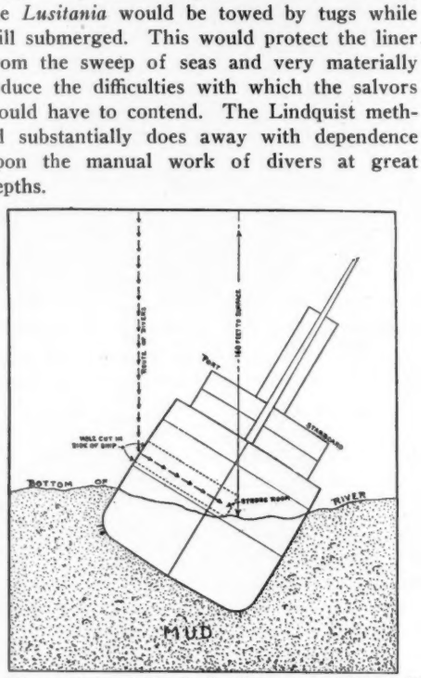
In a compartment at the upper end of his type of pontoon, Mr. Lindquist would install an oil-driven air compressor of sufficient capacity to deal with the expulsion of the pontoon's own water ballast, and by this means control exactly the buoyancy and the lifting impulse of his floating body. Of course, air could also be supplied for this purpose from central compressors located on assailing salvage boats.

When leaving harbor, to go to the scene of operations, these submergible pontoons would carry only enough water ballast to make them rest on the surface with moderate draft in nearly a horizontal position. This posture facilitating towing. When reaching a wreck, the ballast would be so distributed and of sufficient quantity to cause the pontoons to stand upright.

Linked in pairs, their pendant cables would be swept in under a sunken ship as far as possible, and then buoyancy would be applied to raise the bow or stern of the craft so that additional cables, secured to other pairs of pontoons, could be passed beneath the hull. In this manner a large number of pontoons could be assembled over and around the wreck and a great amount of buoyancy brought into play to break the contact with the seabed and to lift the entire load surfaceward many feet. The extent of the lift being independent of the rise of the tide and subject to the quantity of water ballast blown out of the pontoons by compressed air. In this system it is the diameter and not the length of the pontoon which decides how many of them can be utilized.

Mr. Lindquist is satisfied that he could salve the *Lusitania* in this fashion, and he points to wrecks like that of the *Princess May*, a photograph of which is reproduced on the front cover, to illustrate how strong a vessel's backbone is even when much of her weight is borne by only a few supporting points. To raise the *Lusitania* he would use from 14 to 17 pairs of vertical pontoons, each 75 feet long and 28 feet in diameter and able to exert a vertical pull of 1,000 tons. As he explains, the *Lusitania* lies in water of something like 250 feet in depth and rests upon a clean hard bottom, composed for the most part of sand and gravel, with her bow and stern, at the keel, rising in all probability from ten to twenty feet clear of the seabed. In short, he believes the ship is in a position to facilitate sweeping the hawsers for his pontoons alternately under the bow and the stern while rocking her about a pivotal point so as to place cables beneath her at suitable intervals along her whole length.

With his lines and pontoons secured, he would lift the *Lusitania* surfaceward in five stages, tow her landward, and beach her in the sheltered waters of Courtmacsherry Bay seven miles away from her place of sinking. On the journey from her present site to the Bay, the *Lusitania* would be towed by tugs while still submerged. This would protect the liner from the sweep of seas and very materially reduce the difficulties with which the salvors would have to contend. The Lindquist method substantially does away with dependence upon the manual work of divers at great depths.



The posture of the S. S. "Empress of Ireland" partly buried in the muddy bottom of the St. Lawrence 160 *feet down.*

At most, these under-water workers would be expected to make only exploratory examinations and to direct operations at the surface through the medium of the submarine telephone. Viewed from any angle, the employment of vertical semi-submergible pontoons promises to achieve far more at less cost and to do a minimum of potential damage to the wreck than would be practicable by any of the other procedures proposed for salvaging the *Lusitania.* The ship is estimated to represent a total deadweight of about 32,000 tons

It is authoritatively stated that there are more than 1,000 vessels ranging from 200 to 10,000 tons now lying in the waters around the British Isles at depths not exceeding 120 feet. Among the craft that offer alluring prospects to the up-to-date salvors are such ships as the *Justicia, Tuscania, Campania, Laurentic, Britania, Afric,* etc. Not only are the vessels themselves worth vast sums but the value of their recoverable cargoes totals hundreds of millions of dollars. Aside from precious metals, it should be borne in mind that there are many kinds of merchandise that can lie submerged for long periods without suffering injury.

Crude Rubber—Its Production and Uses

Salient and Interesting Facts Concerning the Manufacture of Air Hose Including Millions of Lengths of Air Brake Connections—Present Consumption for Thousands of Articles May Produce a Shortage

By Richard Hoadley Tingley

THE RAPIDITY or growth of the crude rubber industry in the past twenty years has been phenomenal and is only equalled by that of its allied industry; the automobile tire. Before the advent of the automobile, fifty-odd thousand tons of rubber a year was all the trade of the world demanded, and practically all of it came from Brazil and Peru where the very best of rubber grows in a wild state. But the insistent demand of the tire brought scientific, up-to-date methods into play and the cultivation of rubber producing trees in the Far East from seeds taken from Brazil has become one of the leading agricultural industries of the world involving a capital expenditure of a half a billion dollars.

The story of the supplanting of the wild rubber of the Amazon for the cultivated product of the Tropical Orient; of the yielding of haphazard methods to methods of precision—is best illustrated by reference to the following table:

WORLD'S PRODUCTION OF CRUDE RUBBER

(In tons of 2240 pounds)

	Plantations	Amazon	Other	Total
1900	4	26,750	27,136	53,890
1906	510	36,000	29,700	66,210
1910	8,200	40,800	21,500	70,500
1915	107,867	37,220	13,615	158,702
1919	285,000	30,000	10,000	325,000
1920(a) ...	310,000	28,000	9,000	347,000

The Source of all Rubber—The Amazon

There are upwards of three hundred and fifty different trees and vines that produce rubber. There is but one tree that produces the rubber of commerce—the rubber demanded by the trade—the 285,000 tons grown in the Far East and the 28,000 tons that come from the Amazon and this is known as the Para rubber tree, or by the scientific name of *Hevea Brazilienesis.* It is from the seed of this tree, indigenous to the soil of the Upper Amazon and to no other locality that were planted in the Far East, that the two and a half million acres of cultivated rubber orchards have sprung. There are said to be millions and millions of *Hevea* trees in the Amazon country yet untapped for the rubber latex, but the unhealthful conditions surrounding the gathering of the product have kept productions down to the nominal figure we have quoted.

The crude rubber of commerce—the "smoked ribbed sheets," the "first latex crepe," the "up-river-fine" and "coarse," and other forms in which the product comes into the market in response to the demands of the trade, are all from the *Hevea* tree, whether the tree grows wild in the Amazon or is cultivated in Sumatra.

Prior to the time when crude rubber began to come into the market in large quantities from the Orient, and when the automobile tire was making a demand that could not be fully met, the price of rubber mounted to high figures, $3.18 a pound for the best grades, was, I believe, the maximum reached and, in 1908, 1909 and 1910, $1.50 to $2.00 a pound was quite a ruling price, but an increased production and the introduction of economic methods have brought the price down to as low as 38 cents a pound for best grades: indeed, crude rubber is the cheapest commodity the market affords today and is one of the very few essentials—perhaps the only essential—that has been unfavorably affected in price as a result of the war.

(a) Estimated.

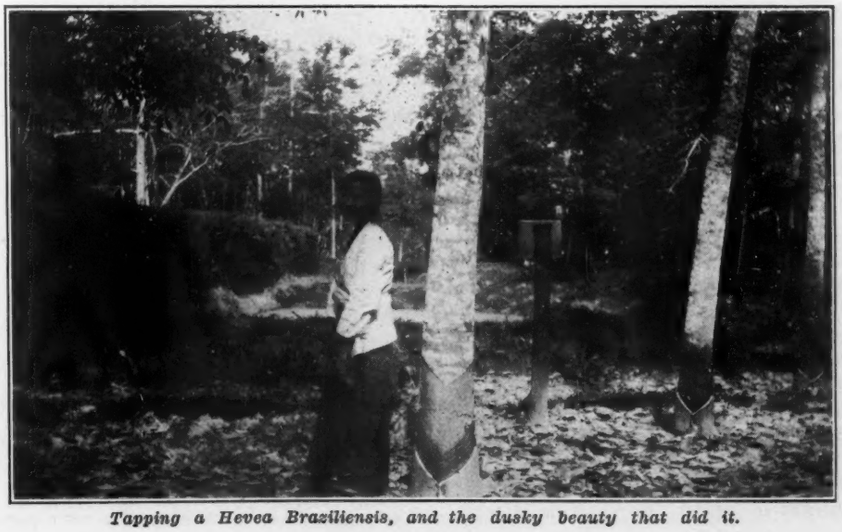
THE PRODUCTION, manufacture and consumption of rubber is inevitably linked with the compressed air industry. The qualities of air hose—tensile and bursting strength, resistance to abrasion, hardness, weight, degree of porosity—all have their effect upon the efficiency of the compressed air plant, and the subject has long been under discussion in the compressed air machinery trade. The author has described the manufacture of air hose in this article and the effect of various material entering into the "mix" which will prove of considerable interest to air machinery manufacturers and users.

Conditions in the Far East have been favorable, during and since the war, and production went on steadily increasing while, in 1918, the United States production of automobiles fell off tremendously from previous years. The surplus of crude rubber that resulted, amounting to nearly 140,000 tons at the end of 1918, has not yet been fully absorbed. This accounts in a great measure for the low price of crude rubber today.

On the plantation, after clearing the tropical jungle and preparing the ground, rubber tree orchards are planted twenty feet apart in squares, making, approximately, 100 trees to the acre. Former practice was to plant the trees nearer, ten feet apart, and a large proportion of the now yielding plantations are so planted but are now being thinned out. The normal average yield is about 450 pounds of pure rubber per acre per year.

Plantation Rubber

A *Hevea* tree is ready to be tapped at about five years of age, and produces rubber as long as it lives in a healthy condition. The latex, or milk that flows from incisions made in the bark, makes about 15 per cent of dried rubber. It is creamy white as it flows from the wound and comes from between the outer bark, or cortex, and the inner bark, or cambium. The tapping commences shortly after the sun rises and continues until about 8.30 a. m. a certain number of trees being allotted to each tapper. When his task is completed he sits down and waits until the tom-tom is struck at about 9.30 a. m. when he commences collecting latex. Collecting is started at the tree which was tapped first, consequently each one has the same length of time to flow. This flow usually lasts for about three hours and stops when the latex which has collected around the tapped portion of the tree is exhausted. This accumulates until the next tapping, when the flow is again the same. Apparently no harm is done the rubber tree by successive tappings, day after day and year after year. The latex collected by the coolie workmen is taken to the plantation factory, strained, coagulated to prevent deterioration by the addition of a small quantity of mild acetic acid, and the elastic mass that is taken out of the coagulating pans after remaining there a few hours is then washed and made into the "ribbed sheets" or "crepe" of commerce by passing through rolls.



Tapping a Hevea Braziliensis, and the dusky beauty that did it.

The crude rubber that comes in sheets of one form or another from the plantation is a practically useless commodity until it has undergone the process of vulcanization which consists of adding a certain proportion of sulphur and subjecting the mass to an extreme heat.

Although Columbus discovered rubber on one of his first voyages and introduced it into Europe it was little besides a curiosity for nearly three hundred and fifty years, until Charles Goodyear, an inventor, quite by accident, discovered the process of vulcanization. Prior to this time, rubber was so sticky in hot weather, and so stiff in cold, that it resisted all attempts to make practical use of it by the many who tried.

Rubber Vulcanization and Compounds

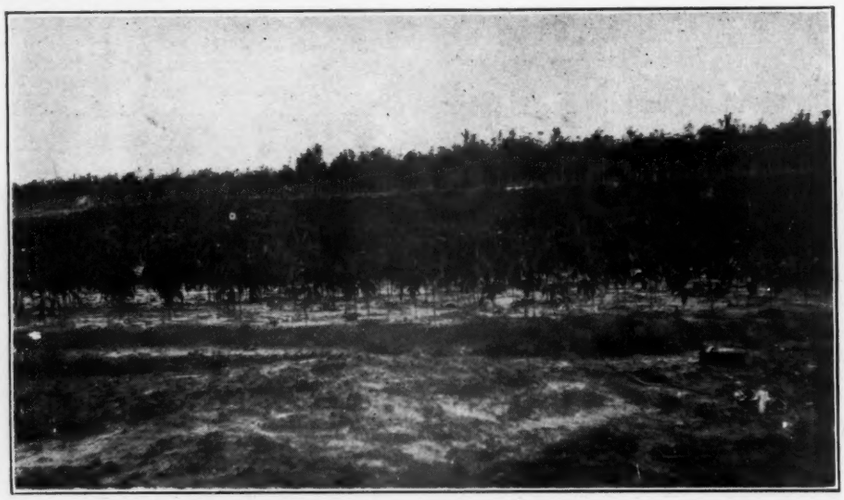
Pure rubber, too, would be an almost useless commodity by itself even with the addition of sulphur and vulcanization were it not mixed with a great variety of other things—to render it more or less tough—to increase its tensile strength to render it capable of resisting abrasion—to reduce its elasticity to meet requirements—to give it hardness, softness, color, weight, and a multitude of other things required in the manufacture of the almost innumerable articles of which crude rubber is the base.

In the manufacture of hard rubber goods a large amount of sulphur is used in vulcanization often as high as 40 per cent—in order to obtain the proper degree of hardness. From this amount, the proportion of sulphur is graded down to as low as two per cent in the manufacture of certain articles of commerce.

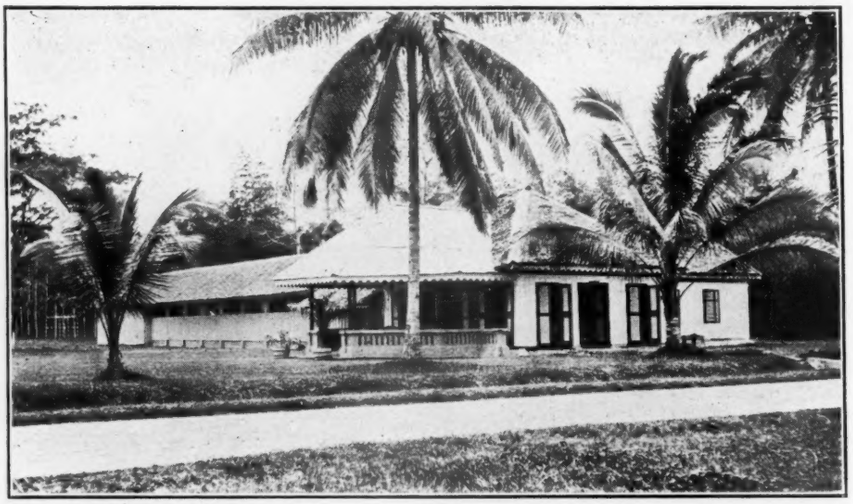
The preparations of the "compounds" which the pure rubber forms the important element, is one of the fine arts in the manufacture of rubber goods of any kind. It is a scientific process in charge of trained chemists who are constantly at work experimenting upon the "mix." In the manufacture of a great majority of the rubber goods of commerce from 30 percent to 50 percent of pure rubber is used, the balance, depending upon the article to be made, is composed of zinc oxide, carbonate of calcium, the sulphates, carbonates and oxides of lead (litharge) calcium, barytes, wax, parafin, lamp-black, etc. For coloring, the sulphides of antimony and mercury, and oxide of iron are used to produce red, chrome green and coal tar derivatives to produce green, sulphide of zinc for white, etc.

In the manufacture of tires, hose, belting and a great variety of articles, cotton duck and yarns play an important part. The "mass" or "batch," containing the proper proportion of rubber and filler to meet the requirements of the case that have been carefully worked out in the laboratory and by intensive experimentation, is "broken up," or mixed by continuous passing through immense mixing rollers. The resulting material is then placed in its warm condition between the top and middle roll of a calendar. This forms a coat of rubber around the middle roll.

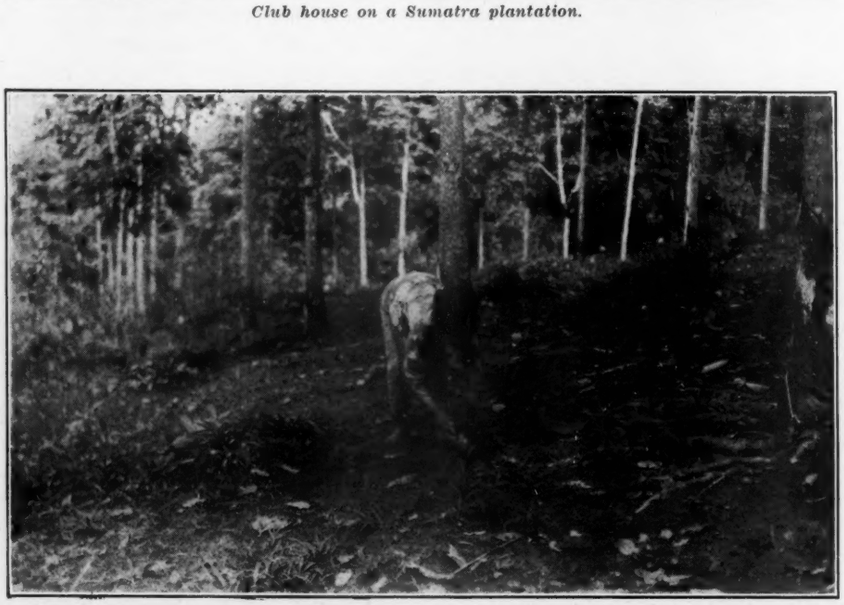
Duck is then passed between the middle roll and the bottom roll and the rubber which is coated around the center roll is forced or impregnated into the duck. This is what is



A young Sumatran rubber orchard, where the Hevea tree is cultivated. Although 350 different trees and vines produce rubber, it is the Hevea tree more commonly known as the Para rubber tree that produces the entire supply of commercial rubber.



Club house on a Sumatra plantation.



Native woman on a Java plantation weeding out a rubber orchard. This has to be done in young orchards quite frequently; but as the trees become older, their own shade retards the growth of weeds and so much weeding is not required.

Latex flowing from a recently tapped rubber tree on a Java plantation into a glass cup.

known as frictioning duck. After this operation is completed the duck is ready to be made up into either belts, hose, packing, or any other item necessary. In making belts, this duck is cut into the correct widths for the belt desired and folded on machines. If hose, the tube is run out of a tube machine to the correct diameter and gage, and this, in turn, is placed over a metal tube or mandrel and the duck, after having been cut on the bias, is rolled around this by a machine and then the cover is rolled around the whole.

It is in this manner, subject to the most severe tests for porosity, bursting, friction, stretching and tensile strength, that the millions of the 22-inch lengths of air brake connections between railroad cars are turned out; that hose for factory use, municipal use, uses in pneumatic tool work; in rock drilling work and for steam work of all kinds are turned out. Apart from the uses of crude rubber in the compound or "mess" I have described for the manufacture of tires, its use in making hose of all kinds is perhaps the most important and antedates its use in tires by many years.

The manufacture of rubber belting is a comparatively recent innovation, taking the place of the old leather belting for all purposes for which the latter has been heretofore used. Rubber belting of all kinds and "ply" to fit the use to which it is designed to be put is now in almost universal use in power driving machinery and conveyor work doing the heaviest kind of duty.

The last 50 years has seen the introduction of so many articles having crude rubber as their essential base that it would be impossible to enumerate them; indeed, it has been said that their number would reach 33,000. Imagine a world without rubber shoes, bands, buckles, combs, buttons, elastics, bandages, erasers, rain coats, fountain-pens, typewriters, nursing bottle tips, rubber heels and soles, rubber tires, sheet packing, piston packing, gaskets and rings, pump valves, billiard cushions, damper regulators, rubber mats, hose and host of other things made possible by rubber and you will have a picture of men and women hunting for a substitute in order to go through their day's work and pleasure. Or imagine, if you can, what would happen if all the rubber insulation now protecting the power and lighting wires that are strung about on the streets and buildings were suddenly to be removed!

Some idea may be gained of the hardships endured by a community suddenly deprived of the rubber to which it had been accustomed by the experiences of Germany during the war. German chemists are said to be among the ablest in the world, but, with all their ingenuity, they were quite unable to produce a substitute and the German authorities resorted to as rigid a commandering of rubber articles, as of copper and gold. When the submarine *Deutschland* made the famous trips to this country before we entered the conflict, one of the principal commodities she took back with her was crude rubber. The world, including Germany, has been experimenting for years in endeavors to produce a synthetic rubber, but the fact of Germany's paucity of rubber during the war and the further fact that, as soon as the war was ended, rubber was one of the first articles they seemed anxious to import, seems to make it clear that synthetic rubber is not yet an accomplished fact.

Although the United States consumes nearly 70 percent of all the crude rubber produced in the world, she is dependent upon foreign soil for all of it. The United States Rubber Company, The Goodyear Tire and Rubber Company, and the Manhattan Rubber Manufacturing Company own and operate large rubber plantations in the Far East, but they are all on alien soil; Dutch. Although the United States Rubber Company owns and operates the largest single rubber plantation in the world, it cannot produce rubber enough to satisfy its own factories; nor can the Goodyear nor the Manhattan. They are all dependent upon the English and the Dutch for their supplies. No crude rubber is grown on United States soil if we disregard the almost negligible quantity that comes from Hawaii and the Philippines.

Mr. H. F. Cameron, Lieutenant Colonel of Engineers, United States Army has recently made an exhaustive study of the possibilities of crude rubber production in the Philippines. His report, as minutely treated in a recent number of the *India Rubber World*, shows that physical conditions are excellent on these islands for the production of a first class quality of rubber. He estimates the cost to develop a plantation of 2,500 acres to be $500,000, or $200 an acre, and that such a plantation should average 500 to 635 tons of crepe a year at a cost of from 20 cents to 30 cents a pound.

Such developments should be really profitable for large rubber interests to engage in, though the high initial cost would keep the small operator out. But it transpires, later, that the Philippines are practically a closed market for our rubber interests—for the present, at least—because the Philippine Government flatly refuses to admit alien labor—Chinese coolies—to work the plantations. This shuts out our Eastern Islands, so far as rubber cultivation is concerned, for without such labor, no planter could hope to compete with the plantations of Java, Sumatra and Malaya. This action has resulted in the withdrawal of the interest that some of our large rubber producers had been taking in the Philippines.

Although there is an apparent surplus of crude rubber in the world today, the famous British authority, Mr. W. H. Rickinson, of London, in a recent article of his "The World's Rubber Position," demonstrates in a most convincing way that there will be a shortage in 1924. He bases his conclusion on the rapid increase in the use and manufacture of automobile tires and other rubber goods, and the rate of increase in plantation production. He shows that the latter is not keeping pace with the former.

During the war, urged on by the thought that, in case we were ever embroiled, in a conflict that would bottle up our ports, as those of Germany were bottled up for four years, intensive endeavors were made to discover a substitute for crude rubber from trees or shrubs, indigenous to our own soil. With this end in view the University of California dispatched Professors Harvey M. Hall and Thomas H. Goodspeed to make a botanical survey of our western areas in search of such substitute plants and trees as had been vaguely reported upon. The professors met with such success that their survey was extended fully a year after the war was over, and their report, which is found in the University of California Publications on Botany, Volume

A cleanly weeded Javan orchard, showing latex flowing from a row of tapped trees.

7—November 7, 1919, and is very instructive and interesting reading.

There is a certain shrub that grows wild and in great profusion throughout the West called, popularly, the Rabbit-bush, or Golden-bush, but which science has given the name of *Chrysothamnus Nauceous*. There appears to be a great variety of the family *Chrysothamnus* though of all the varieties, Nauceous, is the only one interesting from a rubber point of view.

This plant, or shrub is found to contain crude rubber within the cells of its inner bark of such excellent quality that, under pressure, it might be made, even in the wild state in which it now exists, a very serviceable substitute, and would supply all the urgent needs of a bottled up nation.

The shrub grows to a height of from four to six feet and weighs about five to seven pounds. The rubber that is extracted from its bark has been given the name of "Chrysil." A large quantity of the trunk and bark has been analyzed and tested and has been found to contain an average of between five percent and six percent pure rubber that vulcanizes readily and is equal in quality to the best "Para up-river-fine."

The professors found the Rabbit-bush in greatest profusion in Nevada, California and Utah, growing in the dry, slightly alkaline soil of the semi-desert. They estimate, from the areas actually inspected, that the following quantities of wild crude rubber "Chrysil," can now be had:

Eastern Central California and adjacent Nevada..	3,280,000	pounds
Mojave Desert, California	400,000	"
Northeastern California and adjacent Nevada and Oregon	1,000,000	"
West Central Nevada.....	7,680,000	"
North and Central Nevada	23,700,000	"
Utah	20,000,000	"
Colorado	24,300,000	"
Total	80,360,000	"

The seeds and leaves of the "Hevea Braziliensis."

A Java rubber garden or orchard badly overgrown with weeds.

They also estimate very roughly, that including the areas that were but imperfectly inspected by them, there exists, at the present moment, fully, 300,000,000 pounds, or 150,000 short tons of crude rubber to be had for the going after it. As 150,000 tons is nearly half of the world's present production, and following so favorable a report from such a reliable source it is said that prominent American rubber interests are already presenting further investigations looking towards a scientific cultivation of the *Chrysothamnus Nauceous*.

Personal Intelligence

John S. Porter, president of the Federal Sand and Gravel Co., Saginaw, Mich., died recently following injuries received when run down by a motor truck. Mr. Porter was held in high regard by a large number of friends in the sand and gravel industry. He was an enthusiastic worker for the cause and the National Sand and Gravel Association has lost a valued member.

* * *

Dr. C. G. Abbot, Assistant Secretary of Smithsonian Institution, has left Washington for Arizona to establish a solar observing station for the Smithsonian Institution in the Haqua Hala mountains.

* * *

Mr. W. Val De Camp has become associated with the United Verde Copper Company at Jerome, Arizona, as general mine foreman in charge of all underground work.

Mr. De Camp has been for several years, superintendent of mines for the Consolidated Arizona Smelting Company at Humboldt, Arizona, and more recently with the same company as field engineer in which capacity he examined a number of properties throughout Arizona, Utah and Nevada.

* * *

W. J. Swegman has been added to the staff of J. C. Buckbee, president of the J. C. Buckbee Co., Engineers, First National Bank Bldg., Chicago, Ill. Mr. Swegman has had a large experience in designing, building and operating cement plants and is well fitted for his new position.

* * *

Van S. Merle-Smith of New York, has been sworn into office as Third Assistant Secretary of State, and Fred K. Nielson of Nebraska has taken up the office of Solicitor.

* * *

Mr. D. C. Grove of the Ingersoll-Rand Company, New York, has accepted a position as Advertising Manager for the Blaw-Knox Company at Pittsburgh, Pa. Mr. Grove carries the best wishes of a large circle of friends in New York with him to his new duties. The Blaw-Knox Company are dealers in steel products.

* * *

E. C. Harder, of the U. S. Geological Survey, who has examined deposits of iron ore in many countries for the special purpose of determining their mode of origin, has recently made close studies of the action of bacteria in forming iron ores. He has found the so-called iron bacteria actively engaged in the deposition of compounds of iron not only in surface iron-bearing waters but in mine waters to depths of several hundred feet and has made laboratory cultures of various iron-depositing bacteria. The results of these studies have just been published by the Survey as a paper entitled "Iron-depositing bacteria and their geologic relations." (Prof. Paper 113).

* * *

Colonel Edgar Beach Van Winkle, civil engineer, died recently in New York. He served as a private, First Lieutenant and Captain in the civil war from 1862 to 1865 and received his title of Colonel as commander of the First Division of Engineers of the New York National Guard, in which he served from 1876 to 1883. Colonel Van Winkle was born in this city on March 4, 1842, a son of Edgar Simeon and Hannah Beach Van Winkle. He was graduated from Union College in 1860 and received his engineer degree in the year following. Until his enlistment in 1862 he was employed on the Croton water works extension.

* * *

At a directors meeting of the Baldwin Locomotive Works, Thomas S. Gates was elected a director and member of the executive committee. Mr. Gates is connected with Drexel & Co.

* * *

James F. Abbott, commercial attache for the United States at Tokyo, Japan, reports that the proposed extension of hydro-electric projects in that country will involve the building of about 1,000 miles of high tension transmission lines within the next two years, the most of which will probably be of the steel tower type.

Getting Best Results From Rock Drill Bits

An Expert Treatise on How to Increase Drilling Speed and How to Reduce Steel Breakage and Drill Repairs Through the Use of Bits That Stand Up and Drill Round Holes

By Walter E. Carr

THIS article will be of especial interest to those readers who are concerned in mining or rock-quarrying, or in drilling in any stone substance. The mine superintendent and the contractor should read this article with care. Mr. Carr is the inventor of a rock drill bit that bears his name, and in no small measure he has contributed to the progress made in the manufacture and upkeep of drill steels for pneumatic rock drills.

Up to a decade ago the variation and gage of bits on successive lengths of steel probably average a quarter-inch. This meant that the hole had to be large-collared to give the desired diameter at the bottom. The average variation in size of bits at this day is not more than an eighth-inch. Many of the important and progressive mining companies now operate with a variation not to exceed a sixteenth-inch. It is self-evident that this results in greatly reducing the amount of rock to be cut, with a consequent increase in drilling speed.

The principles of the Carr bit, and its modifications, clearly demonstrated that this small variation was quite feasible, and it has now taken its place in general practice. Those identified with western mining will recall the rock-drilling contests which were a conspicuous part of holiday celebrations. Mr. Carr made drill steels for many of these contests.

FEW MEN have become proficient in an art that goes back to ancient times—that of making bits for rock-drilling. The knowledge of these few usually extends only to the practice of their immediate vicinity, or, in most cases, mainly to those methods employed within the four walls of the shop where the work is done. Again, only those particularly interested in the operation of making bits, absorb knowledge through months and years of service with the man who has become expert through hard experimental work and study.

One reason why so few men become expert at this branch of work, is that usually the first idea that enters their heads is to resharpen as many bits as possible in the shortest span of time; therefore, the efficiency of the job is sure to suffer. Doubtless the fine points of the work taught by the expert are forgotten or cast aside as being too "fussy" for general practice. As a result those using these bits have endless trouble.

Nine cases out of ten, at the present day, when trouble is experienced with machine drills, it is steel trouble instead.

The time was, and not so very long ago, that a piece of steel was a piece of steel and a drill bit was a drill bit. So long as it had an edge and carried sufficient gage to allow the following bit to pass to the bottom of the hole, little attention was given the construction of the bit. The idea was to give the bit plenty of spread and clearance. The harder and sharper the rock, of course, the greater the allowance of gage. Frequently one-fourth of an inch variation was used between changes of steel.

The origin of the highly modern drill bit was brought about by making a study of bits for hand-drilling contests. The rules governing these contests were that the last bit used in a set of steel was to be no smaller than ⅞ in. for double hand drilling and generally ¾ in. for single hand drilling. Sometimes, however ⅞ in. steel was used for single hand drilling also. The steel used in double hand drilling being ⅞ in. in diameter and for single hand work ¾ in.—the reader will note that the last bit was the same size as the steel. This rule was carefully adhered to for there were times when some shrewd fellow would swage the last drill down for some distance back of the bit and make his last bit smaller than the steel. This was done to enable him to drive the last drill through the rock a little faster and thereby increase his chances of winning the prize, which would cover him with glory, beside supplying funds for a "big time," where the said funds usually went after the contest was ended.

This swaging, of course, was barred, but the rule of using a bit the same size as the steel always has been, still continues, and doubtless always will be enforced in hand drilling contests.

In a study of this bit-making, the first thing to learn was why the last bit would drive through the rock when only ⅞ in. in diameter. In other words, why did it cut a margin large enough to permit the drill steel which was ⅞ in. to follow the bit and also allow for cleaning the hole, which is done by using a small stream of water constantly running into the hole. The blow splashes or drives the cuttings past the steel so effectively that a hole 50 in. deep can be cleaned without an effort on the part of the driller, aside from the blows on the head of the steel, if the bits are made properly.

A theory was advanced and much experimenting was done. Of course, granite was used for all professional drilling and all experimenting was done in the same class of rock.

Hole after hole was drilled, one minute the hammerman striking slow and very hard, the next minute striking very fast and light. Afterward the rock was split to determine the result. The heavy hitting would make a much larger hole than the light hitting, and showed plainly that the vibration cut the margin.

In a set of steel for drilling in a contest of fifteen minutes duration, fifteen pieces of steel are used, or one steel for each minute. The contestants generally figure they will drive, or at least should drive three inches or more each minute, therefore there is a difference of at least three inches between each length of steel. Usually one of the drillers does all of the changing of steel and this is done every minute and allows an additional three inches of steel to be driven into the rock.

When it was fully demonstrated that a ⅞ in. bit would accommodate a ⅞ in. piece of steel for drilling one minute in granite, why then would it not be a good idea to make all bits the same size, for if one ⅞ in. bit would cut a hole large enough to accommodate a ⅞ in. piece of steel, then it certainly looked feasible that the whole set of fifteen drills would work the same way. If this could be done then a great stride would be made in drilling speed for the minimum amount of rock would be cut to drive a hole ⅞ in. diameter, for the hole would be ⅞ in. diameter from the collar to the bottom. First only two bits were tried, both being as perfectly formed as possible and both being ⅞ in. size.

When tested they worked perfectly and the idea was found to be a success. A full set of steel was then made and tried and found to be far superior to a bit with gage. They drilled a hole perfectly round and no matter how poorly they were turned when drilling, the bottom of the hole, could be kept practically smooth.

This was another feature of great importance to drillers for, when the drillers make a change or, in other words, when the driller twisting the steel arises to take his turn at the hammer two blows are usually struck by each man, the drill bouncing in the hole. This is called "fostering" by drillers and a bit that will bounce around is more valuable than one that remains in the same spot. If the hole is smooth in the bottom and is kept that way by the bit, the steel will move freely. This shows that such a bit turns easier than a bit with gage, or, at least, with a gage usually used in making drills at that time.

In forming a bit for such drilling it was necessary to make them heavy and strong and of course the degree of hardening was of great importance. It was also necessary to make the bit so it would have the proper clearance, in order that the cuttings would be discharged from the hole. It was also necessary to study the cutting edge pitch to reach a happy medium in a bit that would cut fast and at the same time splash the cuttings from the hole without any effort on the part of the driller, other than hammering. An edge of about 90 deg. pitch seemed to give good results.

It was necessary to flatten and taper the bit slightly on two sides to allow the proper clearance necessary to give the cuttings a good start from the bottom of the hole. The flattening did not extend very far back from the bit and the tapering was not very pronounced, as it was necessary to leave as much metal as

possible on the two rounded sides of the bit for the rounded, or corner sides, were those that held the gage and were directly adjacent to the advancing corner of the bit. These rounded corners formed the reaming edges of the bit and served to keep the hole perfectly round and furnished many times as much metal to be worn away as ordinary bits with a sharp corner sticking out which were designed to use gage.

Doubtless the reader could picture the bit in his mind better by taking a perfectly round stick ⅞ in. in diameter and whittling off a small portion on one end, by tapering the stick slightly or say, cutting away about ⅛ of it on opposite sides, thereby tapering it abruptly to 90 deg. on the extreme end to form the cutting edge of the bit, the cutting edge being formed by the continuation of the flattened sides being brought together by the 45 deg. bevel on either side. This naturally forms the 90 deg. cutting edge. The rounded or corner sides of the bit, the reader will note, is now a perfect circle and instead of only a small point sticking out to hold the gage, the whole rounded sides are corners or reaming edges. These edges were ample to hold the gage of the bit for the hardest kind of service over a period of one minute, therefore it was possible to make all the bits the same size and have them follow perfectly in granite, while the steel used in this work was made from ⅞ in. octagon bars, after being cut to the proper length for a set of drills each piece was turned in a lathe to ⅞ in. round, leaving only enough of the octagon for holding and turning.

When forming the bits, a reasonable amount of care was exercised not to heat them too hot, which means burning, and also not to hammer them after they reach a temperature of about 1400 deg. F., or a cherry red. If hammered too cold, strains are created which only annealing can remove, also the construction of the steel is broken or injured and naturally weakened.

In later years this same idea of reaming edge bits has been adopted by our large manufacturers of power drills and they are manufacturing equipment for sharpening machines which will, if handled properly, shape the ordinary four-point bit into the reaming-edge bit, thereby increasing its life many times, besides increasing the drilling speed greatly by cutting down the size of the bits used.

This equipment also enables the sharpening machine operator to gage his bits very accurately, thereby eliminating much trouble underground from steel sticking and broken bits to say nothing of time saved in changing steel and of the smaller number of bits to be re-sharpened.

There are large mining companies, who have increased their drilling speed 30 per cent and cut down the number of bits to be re-sharpened by half, simply by the strict adherence to the use of modern drill bits and sharpening equipment.

Too many are inclined to treat the idea of increasing their efficiency through the sharpening shop slightly, and give it very little attention, while on the other hand, if shown where one per cent can be saved in other departments, expensive changes will be made to meet it.

One of the largest mining companies in the world, which operates numerous mines in the same camp, have one man who is an expert in his line and who does nothing but travel from shop to shop and follow up the idea of making bits as perfectly as possible. They find it pays in big returns.

Increase your drilling speed, reduce steel breakage and save drill repairs by using bits that stand up and drill a round hole when properly made.

TO MAKE A BUSINESS OF INVENTING

In a recent address Mr. R. O. Herford, works director at the Hans Renolds establishment, Manchester, counseled his hearers—all representative of the administrative side of Sheffield industry—"to look out for the man with a genius for invention, take him off production, where he is worried and ineffective, give him a quiet room and a lathe and let him invent things for you. When there are two or three such men in the works, it is wonderful what results are achieved." Mr. Herford made a point of the fact that if the work of the technical experts was to be applied successfully, all projects should be discussed by conferences attended by the manufacturing, toolmaking and inspecting departments, and experimental models should be made for testing purposes.

VACUUM STORAGE TANK

By E. F. CREAGER

In American Machinist

We received several drums of plastic molding material that had an excess of moisture, and having a large steam-heated tank for vulcanizing under pressure I desired to use it for drying the molding material in vacuum. I therefore ordered the millwright to connect up a pump to the tank as quickly as possible. He said he would rush the work; and in a few hours he was back saying, "I have her all connected up; but where shall I put the other tank? "What other tank?" says I. "Why the tank to pump the vacuum *into*."

In considering the serious shortage of gas and coal and the prospect faced by many companies of shutting down next Winter, the proposal has been made that the cities of New York and Philadelphia be permitted to abolish the candle power standard of gas, utilizing instead the thermal unit basis of measurement. Through this expedient enough gas-oil could be saved to supply all of the New England states, according to an announcement of the American Gas Association. The contention of the gas association is that the candle power standard is out of date because the true value of gas lies in its heating power not only in cooking, but also in incandescent burners. There appears to be a strong basis for this reasoning. The old open flame burner has become practically obsolete, and therefore, heat, not light, should be the proper measure of gas.

THE THINKER

By BERTON BRALEY

Back of the beating hammer
By which the steel is wrought,
Back of the workshop's clamor
The seeker may find the Thought.
The thought that is ever master
Of iron and steam and steel,
That rises above disaster.
And tramples it under heel!

The drudge may fret and tinker,
Or labor with lusty blows,
But back of him stands the Thinker,
The clear-eyed man who Knows.
For into each plow or sabre
Each piece and part and whole,
Must go the Brains of Labor
Which gives the work a soul!

Back of the motor's humming,
Back of the belts that sing,
Back of the hammer's drumming,
Back of the cranes that swing,
There is the eye which scans them,
Watching through stress and strain,
There is the mind which plans them—
Back of the brawn, the Brain!

Might of the roaring boiler,
Force of the engine's thrust,
Strength of the sweating toiler,
Greatly in these we trust.
But back of them stands the Schemer,
The Thinker who drives things through;
Back of the Job—the Dreamer,
Who's making the dream come true!

NO METRIC SYSTEM FOR NAVY

In addition to the recent order of Secretary of War Baker directing the discontinuance of the use of the metric system, the Navy Department also, through prominent officers, expresses its opposition to that system.

Admiral Griffin, chief of the Bureau of Steam Engineering, in an interview said "that to make a change to the metric system in the Navy would cause havoc with repair work and that he had no idea Congress would be ready to make the large appropriation required to meet the cost of a change."

Admiral McGowan, at the head of the Division of Supplies, points out the serious burden which a change would place on his department.

The commandant and superintendent of the Naval Gun Factory, Washington, says, "It is not believed the time is ripe for the adoption of the metric system."

The executive committee of the American Association of Engineers has asked its chapters situated in states along the Canadian border to urge upon the President of the United States and the United States Senators representing their respective states the desirability of appointing an engineer to the vacancy on the International Joint Commission, in recognition of the large engineering problems involved in the work of the commission.

AIR PROVES USEFUL IN THE PAPER MILL

AIR SEEMS to be in one way or another, a necessary agent in every line of industry, but its specific functions find quite various employment. In the general use of compressed air for the transmission and application of motive power, as in the driving of rock drills and pneumatic tools in general, the moisture carrying habit of the air is a decidedly objectionable feature while in the paper industry this same habit and facility render it indispensable. In the successful conduct of a modern paper mill one of the most important requirements is proper ventilation, and this for two distinct reasons.

In the first place, the men who work in the mills have been elevating their standards of health and comfort and are more exacting in their demands for proper working conditions. It is ultimately to the interest of both employer and employee that such conditions be secured. A specific instance is cited of how workmen's views have changed. The superintendent of a certain mill before the war had little difficulty in getting all the competent help he wanted. His people were satisfied with moderate wages and with the working conditions as they were, but when the war came on with the changes it brought over everything he found that he had to wake up. He found help hard to get and hard to keep, and his product was not as satisfactory and reliable as it had been.

Extensive alterations were made in the mill arrangements. A high grade ventilating system was installed to carry away the steam and moisture. Fresh air was supplied to all parts of the mill with a surprising change in the atmosphere and in the general working conditions. The result was almost immediate. The human atmosphere was cleared. Discontent disappeared, the workmen lost their listless ways and had no further thoughts of running away. The human element is a factor so big in all manufacture to-day that plans which can be worked out to proper working conditions must be formulated and adopted.

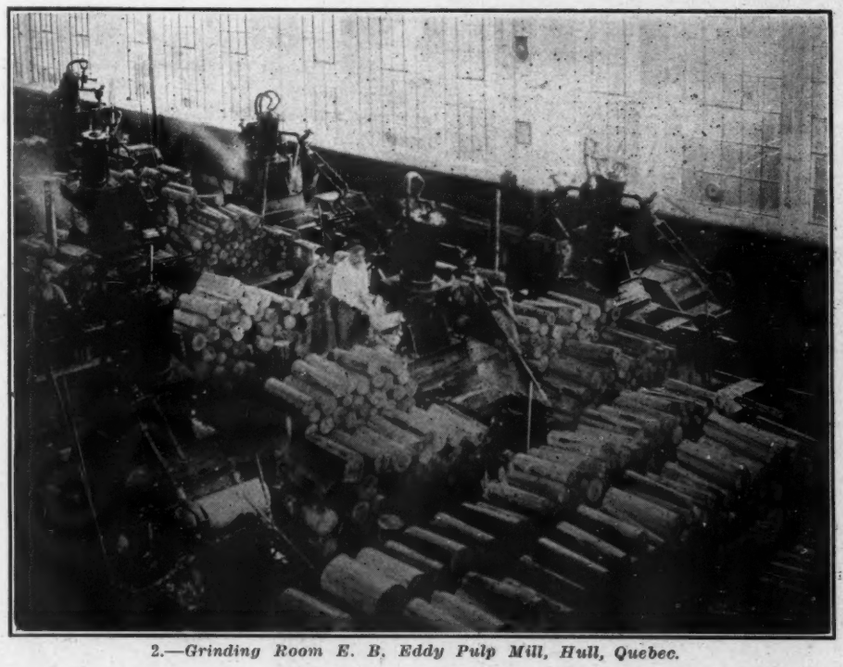
The superintendent found also that due to the great demand for his paper his output must be increased and should be made independent of changing weather conditions, and this was all secured by a proper ventilating equipment which controlled both temperature and humidity. The system was extended to the entire mill; not only in the pressure of the final processes where the paper is actually made and finished, but where the rags are sorted and dressed and then mechanically dusted, and in the rooms where bleaching, boiling and the washing, processes are subjected to chemicals, foreign matters and high temperatures.

Water is evaporated in beater, jordan and machine room, but of course to the greatest extent in the last mentioned, where a great amount of moisture is given off. Paper machines of the Fourdrinier type consist of 20 to 80 or more rolls, arranged two, three or four decks high, and through these steam heated rolls the paper passes from the wet to the dry end, constantly giving off moisture in transit. Paper or pulp board usually enters a machine with moisture content of about 60% and leaves containing about 5%. Pulp goes to a machine with a moisture content of very nearly 100%, but after passing the last press rolls, the water is reduced to about 60%, and from this amount down to the final 5% the evaporation is produced by the steam heated rolls and by hot air delivered between the rolls when a modern fan system is used.

The amount of air to be delivered between the rolls of paper machines should be figured on the basis of fifteen grains of moisture picked up per cubic foot of air. As an example, take a pulp board machine producing 75 tons of dry material per 24 hours. This calls for evaporation of 9,600, or say 10,000, pounds of water per hour, which equals 1,167,000 grains per minute. Allowing fifteen grains per cubic foot of air, this calls for 78,000 cubic feet of air per minute.

The air should be delivered to the machine at from 140 to 150 degrees Fahrenheit. If this temperature is exceeded the quality of material tends to be lowered, due to a reduction in strength. The distributing pipes between rolls are usually six inches in diameter, the length being about the same as the length of the rolls. Air emerges from these pipes through slots six inches long by one-half inch wide. These slots are arranged in two rows, end to end, with just a small bridge between each two slots so as to retain the strength of the pipe.

1.—Paper Machines in Perfectly Ventilated Room of the Otis Mill, Chisholm, Maine.



2.—Grinding Room E. B. Eddy Pulp Mill, Hull, Quebec.

In addition to the air delivered between the rolls of paper machines as mentioned above, a regular distributing system should be arranged, conduct depending upon the locality of the mill as this varies in either northern or southern climates. A great many mills have worked out their plans along the above lines and they find that not only are working conditions much more satisfactory in every respect, but the finished product enables them to charge a better price and to finish the paper much faster and easier.

STIFF HATS TO PROTECT HEADS OF MINERS

*By C. LORIMER COLBURN**

The use of helmets during the war has accentuated interest in the advisability of using stiff hats in mines to protect the miners against falling rocks. About 40% of the accidents in mines are due to falling rocks or roof. A large number of these accidents could be prevented if the miners wore stiff hats or helmets.

The use of head protective devices in mines is not new, for they have been in use for many years in Europe and in the Lake Superior District in the United States. In practically all of the mining districts in Europe stiff hats of some kind are required by the mine management. George S. Rice, chief mining engineer of the Bureau of Mines, reported that in Germany, Belgium, and France stiff hats made of paper mache or felt rosin are in use. Similar hats are generally employed in the Lake Superior District. In building the subways of New York and Philadelphia it was the practice of engineers and workers to let the hair grow very long and to wear a close fitting cap or felt hat. In Germany the hats are high like the military helmets, whereas in France and Belgium they fit more closely to the crown. In England the practice is mixed. As a rule the miners use soft padded caps, but in Yorkshire many of the miners use sole leather, tight-fitting caps of jockey pattern with the seam forming a little ridge down the middle of the cap. These hats are very useful in low thin beds of coal, as in crawling one is very likely to strike his head on a sharp piece of rock or on a timber. Of course, such mishaps are more likely to occur to a man not familiar with the mine. It must be admitted such hats do not stick on well, though this is usually due to their not being especially fitted. *The German hat is particularly unsuited to an American-shaped head.*

It is interesting to note that on the continent tight cotton caps are generally worn over the hair and under the hard hat. This is a measure for cleanliness which is excellent. In low beds of coal where much crawling on hands and knees is necessary the dirt and coal dust sift down, making the miner black and dirty. In metal mines stiff hats are of especial use in shaft work; also in raises or high stopes. A small fragment of rock falling some distance either down a shaft or raise would kill a man if it struck him squarely on the head. A stiff hat or helmet may protect him and save his life. At a station in a shaft where men are loading the cage or skip, some kind of adequate head protector should be compulsory. A head-protecting hat or cap which is also a good insulator should be worn where there is danger of striking one's head against a wire carrying an electric current.

*Assistant chief mining engineer, Bureau of Mines.

VARIETIES OF WIRE ROPE IN CROSS SECTION

FROM THE attractive and intrinsically valuable publication of The Texas Company, *Lubrication*, is here reproduced a group of cross sections of wire rope, with a brief note descriptive of each. It will be noticed that all but one of the entire dozen have hemp centers as indicated by the solid block.

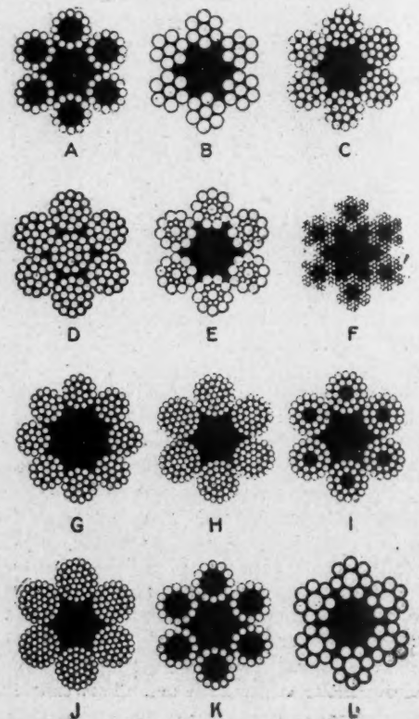
A. The usual form of flexible steel rope, consisting of six strands of twelve wires each. This form is much used for hoists, lifts, etc., and is commonly known as compound running rope.

B. This form is known as a haulage, transmission or standing rope. It consists of six strands of seven wires per strand and is suitable for work where the size of sheaves is not too small. Capable of resisting external wear.

C. A hoisting rope, composed of six strands, each consisting of nineteen wires and laid about a hemp core. Less able to resist abrasion than "B" but considerably more flexible and one of the commonest forms used.

D. Another form of hoisting rope not possessing the flexibility of "C." This rope consists of six strands, each of nineteen wires, laid around a wire core.

E. This particular form is known as cable construction and is suited for hauling purposes. It is a stiff form of rope and should not be used where sharp angles are encountered. It will stand considerable abrasion.



Typical cross sections of wire rope

F. A form of cable construction commonly called tiller rope. This form is the most flexible made and can be bent around small sheaves, but as it is made of small wires it will stand little external wear.

G. An extra flexible rope composed of eight strands of nineteen wires per strand. This type is very suitable for hoisting and can be used over smaller sheaves than "C."

H. Slightly different form of extra flexible hoisting rope consisting of six strands each containing 37 wires. This rope may be used over fairly small sheaves but not under conditions where it will be subjected to external wear. Suitable for cranes.

I. Construction employed in laying up steel hawsers and mooring lines. These ropes are usually composed of galvanized wire.

J. A galvanized hawser similar in construction to the hoisting rope "H."

K. This rope is used for mooring lines and hawsers and with the exception of the fact that the wire is galvanized the rope is very similar to that described under "A."

L. A rope suited for hoisting and deep well drilling.

The flexibility of a wire rope depends upon the number of wires of which it is formed, the size of these wires, the method of laying and the nature of the core. Consequently the makeup of a rope limits its field of application. Speaking generally, the greater the number of wires in a rope the greater the flexibility. A first-class wire rope is about as flexible as a new hemp rope having the same strength and can be run over the same size sheave without damage, provided the score on the sheave is arranged to fit the rope.

AIR MACHINERY EXPORTS FROM UNITED STATES

The Bureau of Foreign and Domestic Commerce has provided for publication the following table of exports from the United States of air compressing machinery, by countries, in the last month for which records are available, May, 1920.

Countries	*Dollars*
Belgium	74,128
France	86,703
Italy	51,121
Netherlands	2,489
Norway	305
Roumania	12,245
Spain	82,698
Sweden	661
Turkey in Europe	3,884
England	69,137
Ireland	1,561
Canada	35,446
Guatemala	120
Salvador	530
Mexico	11,350
Newfoundland and Labrador	611
Cuba	12,574
Dominican Republic	85
Argentina	4,419
Bolivia	219
Brazil	1,850
Chile	4,197
Colombia	49
Paraguay	1,686
Peru	10,052
Uruguay	2,437
China	142
Kwantung	4,946
British India	543
Straits Settlements	1,200
Hongkong	10
Japan	29,407
Australia	11,387
New Zealand	772
Philippine Islands	3,615
British South Africa	23,194
French Africa	7,315
Morocco	720
Total	$553,808

Research Plant for Investigation of the Air Lift

By EUGENE P. McCRORKEN

THE AIR lift system is—even at the present time to a large extent—an unknown quantity among engineers. It has always been of interest having gained immediate recognition years ago as possessing possibilities which would prove of decided advantage over other systems of pumping water. Its simplicity, reliability, absence of working parts, and therefore resulting absence of repairs, are features that involve fundamental mechanical advantages which appeal alike to designing engineers, municipal water supply men, and those responsible for carrying on operations in industry in general. The fire hazard has been reduced to a minimum by its introduction, which fact has been accepted by underwriters generally and with a corresponding reduction in insurance rates.

However, the absence of accurate technical data for making installations has militated against a wider introduction of the air lift. In making recommendations to his board of directors, a designing engineer is chary of taking any chance with devices, the performance of which he has not complete and accurate data in his possession.

The writer's purpose in publishing this article is to recount how one progressive manufacturing company has realized and appreciated this absence of technical information and has installed a complete testing plant on a full size scale, equipped with accurate instruments for measuring air and water in quantities dealt with in every-day plant operation. This extensive laboratory outfit was constructed by the Ingersoll-Rand Company at Easton, Pa., and it is probably the only one of its kind in existence.

The purpose of the following description is to convince engineers, who surround the air lift with an atmosphere of mystery, that scientific research work intelligently performed will yield results on which formulae may be based that will permit the calculation of quantities of air and water within an accuracy of two per cent. It is entirely plausible that previous practise in making installations has been wasteful to a degree as the correct proportioning of the various elements—air, water, submergence, lift, etc.—is important if high efficiency is to result, and operations at this plant have revealed that many simple variations in these factors result in comparatively large differences in results.

The tests being conducted at the time of the writer's visit were to determine the effect of various lengths of tapered pipe and the effect of different degrees of taper. Results so far have revealed interesting information and have shown considerable possibilities in increasing efficiency and maintaining it under the operating requirements of the ordinary industrial plant. This interesting plant is also available for the testing of special devices such as foot pieces, etc.

Equipment to Maintain Definite Water Level

The equipment consists of a well driven about 300 feet in depth and fourteen inches in diameter. In order to provide a well with a large capacity for obtaining measurements of air lift performance it was arranged to run back the water pumped. This was done by placing a fourteen-inch diameter pipe outside of the eleven-inch pipe which later, to all intents and purposes, served as a well itself. In the annular space between the eleven-inch and fourteen-inch pipe, water from the flume is

View of concrete flume and V-notched weir showing the method of baffling the water.

Instrument used for obtaining exact height of water level.

siphoned down the well. This syphon also acts to prevent any air bubble formation which would cause inaccuracies in the measurements. By syphoning this water back into the well a definite variable water level can be maintained which permits tests to be carried out with different heights of lift and corresponding submergences. A gate valve operates in the syphon pipe and quantities are minutely adjusted by operating a by-pass of small diameter pipe with valve in order to vary the water level as desired.

To measure the height of water in the well which in turn gives the depth of submergence, a three-eighth-inch auxiliary pipe is led down alongside the discharge pipe to which is attached an air gage. Air is admitted into the pipe and then by means of a stop cock is locked in. The pressure read upon the gage is that corresponding to the column of water in the pipe, or the submergence, which can be easily calculated. The factor of any bubble formation having been eliminated by means of the syphon feature readily will be seen to be important.

The eduction pipe is provided with the usual standard umbrella top. In the eduction pipe is placed a thermometer well for reading temperatures of the water and air mixture. The inlet air temperature down the three-eighth-inch pipe is taken at frequent intervals at a nozzle in the air pipe.

Measurement of Water

The water measurement is obtained from a 90-degree V-notched weir set in the flume as shown in the illustration. A float inside a glass container with a vertical brass arm attached with indicator on a graduated scale is used for obtaining the exact height of the water level flowing over the weir. The altitude of the bottom of the V-notch is obtained by taking the average of frequent and repeated readings on the float. A device for determining the amount of capillarity of the water in order to make the proper correction on the float reading was invented by Mr. S. B. Redfield.

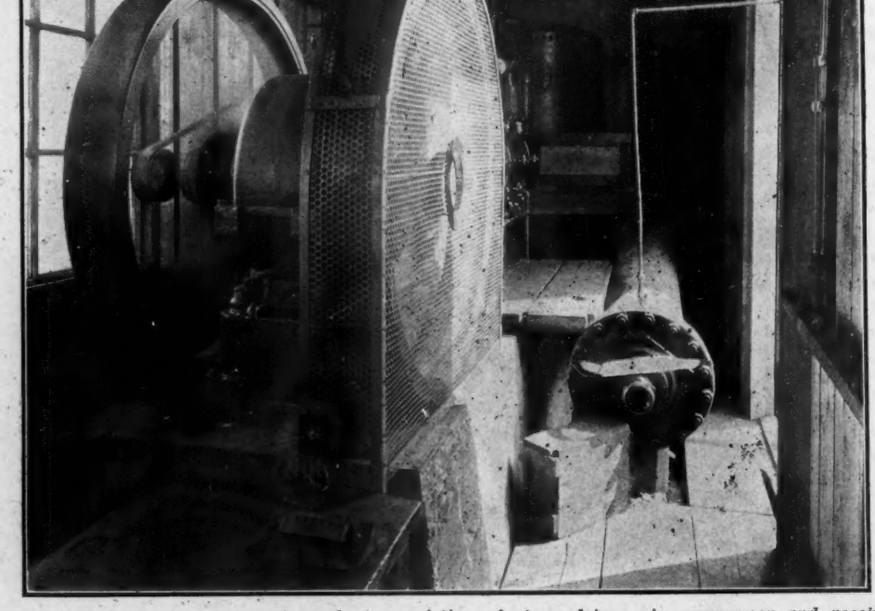
In the accompanying illustration wooden baffles with three inch holes, through which the water flows, are placed at intervals along the flume to prevent any slight swashing of the water level which would cause variations in the readings on the float gage. For the same reason, wooden planks, which can also be seen in the illustration piled up in the rear of the baffle, are used to cover the flume for a considerable distance preceding the weir to prevent the action of the wind causing ripples on the surface which would also cause interference with the float gage readings. This method therefore insures a close degree of accuracy in measuring the volume of water being lifted.

Measurement of Air Volume

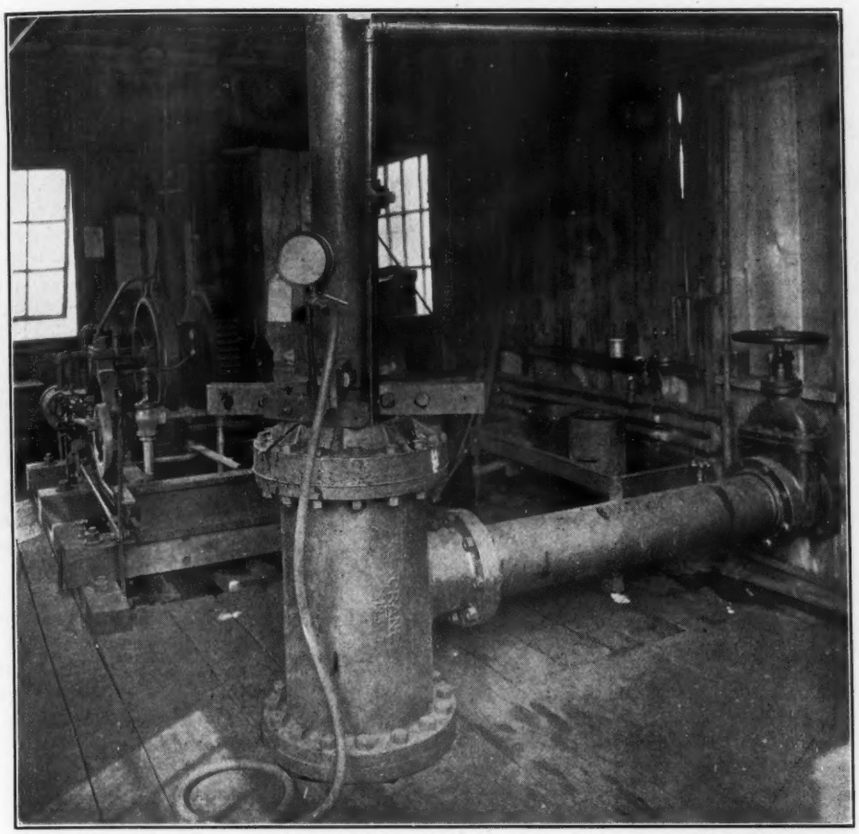
The air used in the system is measured by the well-known method adopted by the American Society of Mechanical Engineers. A large cylindrical tank is used with a rounded orifice in one end through which the air is sucked in. A pipe is inserted in the tank and connected to a barometric pressure gage in order to obtain the pressure. A recording thermometer is placed in the path of the entering air and from these two known quantities—pressure and temperature—the amount of air being used in the system may be calculated. This method has proved satisfactory as only a slight fluctuation occurs in the levels of the liquid in the barometer and an average of repeated readings is taken. It is probably the best for measurement of air up to a certain quantity. After the amount becomes larger than this critical point, vibration occurs at the orifice, which sounds a musical note and the rapid fluctuation of the barometer level prevents any degree of accuracy in the reading.

A 58-ft. steel tower is used for raising and lowering pipes in the well.

The tower shown in the illustration is used to hoist the pipe to the different lifts varying from twenty feet to 150 feet and submergence from 30 per cent. to 80 per cent. Efficiencies are then plotted after an extensive number of trials. From these results it is now possible for the engineers to predict with accuracy, probably closer than two per cent., the efficiency of the air lift system at a certain height of lift and per cent. of submergence with and without the use of foot pieces, tapered pipe, etc. These tests are of the highest value in calculating the amount of water which will be lifted through a certain diameter pipe and with a given air compressing equipment.



Independent air compressing plant consisting of steam-driven air compressor and receiver with various measuring and recording instruments.



Fourteen-inch well head and horizontal section of syphon and main regulating gate valve. The by-pass is not shown.

This system, since its installation, has been used for numerous tests, as described, which have revealed exact data which has well repaid the expenditure of effort and money. That such a plant fills a real need in this particular field is beyond doubt. The information contained in the foregoing was obtained through the courtesy of Mr. H. T. Abrams, in charge of the Air Lift Department, and Mr. S. B. Redfield, engineer in charge.

DESERT ENGINEERING FEATS SHAME ALADDIN

WHAT FRENCH engineers, by the sinking of wells, have wrought in transforming the desert places in the Algerian Sahara into fruitful garden, is nothing less than miraculous in the minds of the Arabian chiefs, who have doubled and quadrupled their fortunes because of it. And scarcely less wonderful, according to Arab reckoning, are the roads which the French have built all through this section, linking up the railroads at Tiguig and Toggourt with the chain of cases which their skill has caused to blossom like the rose.

In connection with this project it is interesting to note there is a large demand for American windmills in Tunisia, where in the city of Tunis district, Illinois salesmen already have made the landscape look as American as possible.

Between Tunis and Carthage there are hundreds of American wind-mills turning away merrily. One is perched on the edge of the ruins of the ancient Carthaginian amphitheatre which was destroyed by the Romans some 1800 years ago. Elgin and Rockford salesmen have been busiest in the Tunis region. From talks with the natives, both French and Arab, it appears that the windmills are delivering the goods and that many more will be brought in just as soon as the rate of exchange is more favorable.

One of the first aspects of this new prosperity, introduced by the oasisation process, has been, oddly enough, the gradual disappearance of the camel. In the unenlightened days, the Arab was satisfied to jog along on the backs of swaying Bactrians or dromedaries, carrying his figs and dates to the market towns across the desert. There was no competition, as every one else depended upon the same slow means of locomotion. But to-day if he is to dispose to the best advantage of his bumper crops, he must learn to conduct his affairs with a liberal inoculation of Yankee pep.

And one of the most compelling arguments that led him to this conclusion has been the automobile. Cars of light and inexpensive make, —particularly of a certain American model, get across the sands without sinking, as do the heavier cars. Quantities of them have therefore been bought by the prosperous Arabs, and now, fitted out with water tanks ten times the storied capacity of the camel, "to go eight days without a drink," skim lightly from oasis to oasis, whenever rains have hardened the sand, or along the French highway toward the El Guerrah-Toggourt desert railroad.

An American Red Cross worker, who recently completed a medical tour of Algeria was the first to bring back reports of the widespread popularity of the auto as the modern "ship of the desert." He further adds that this year, thanks to the progress made by the engineers with their system of wells, there will be such an abundance of fruit that quantities of dates will be shipped to Biskra, the great market town which is the clearing house for hundreds of Arab fruit growers.

Thus it would seem that American commercial penetration in this district as well as in Algeria has been resumed after a period of stagnation due to the war.

THE USE OF HIGHER AIR PRESSURES PROPOSED

PROBABLY MORE compressed air is used for power transmission and operation purposes at pressures of 6 to 8 atmospheres than at any other range of pressures so narrowly limited. Even for various special services we do not commonly go beyond 20 or 30 atmospheres, and when in the liquefaction of air pressures of 150 to 200 atmospheres were used it was regarded as a marvelous achievement, and a probable approach to the limit of possibility. When the officials of the chemical works at Oppau, in Germany, were explaining to the allied commission their processes of manufacture, they made a great point of the difficulties they had overcome in developing the Haber process of extracting nitrogen from the air by applying a pressure of 200 atmospheres to large volumes of hydrogen.

A writer in a recent issue of the *Technical World* believes that the above view is wholly unjustifiable, and that it would be advantageous and easy to use a pressure of, say, 1000 atmospheres, instead of 100 or 200. Cup leathers, it is well known, become more effective as the pressure increases, and the author's experience has shown that they will stand much higher pressure than any they have yet been subjected to. By observing certain elementary precautions he had realized with the help of simple plunger pistons, compressors capable of compressing 100 cubic metre of gas an hour up to 1,000 atmospheres density. To compress to 1,000 atmospheres needs only the addition of one or two small cylinders to an installation for lower pressures. Moreover, the law of isothermic compression shows that the work required to compress to 1,000 atmospheres will be only 3 as against 2 for 100. A tight joint is more easily made with the higher pressure, for it is correspondingly smaller on account of the reduced size of the apparatus.

We can readily concede the possibility of producing such high pressures, but we do not as yet see any call for their employment. Certain complications as to temperatures, working clearances, etc., are not to be ignored, and in combination they must impose a limit somewhere.

A new word which surely had to come and which would have made itself if it had not been launched by the Goodyear Tire & Rubber Company, is "Truckportation," meaning to carry by truck, which nobody will need to be told.

The International First Aid and Mine Rescue Contest

By F. J. BAILEY
Assistant to the Director, Bureau of Mines

THE EVENT of the year, as far as the million miners of the United States are concerned, is the International First Aid and Mine Rescue Contest that will be held in September at Denver, Colorado, under the auspices of the Bureau of Mines.

The contest will be open to all bona fide first aid and mine rescue teams connected with the mining and metallurgical companies of the United States, Canada and Mexico, and prizes of gold medals, cups and banners will be awarded to the teams most proficient in the art of saving human life. A number of similar contests have been held in the past by the bureau and each succeeding contest has shown increasing enthusiasm among the mining fraternity until today these events are looked upon as red-letter days in their history.

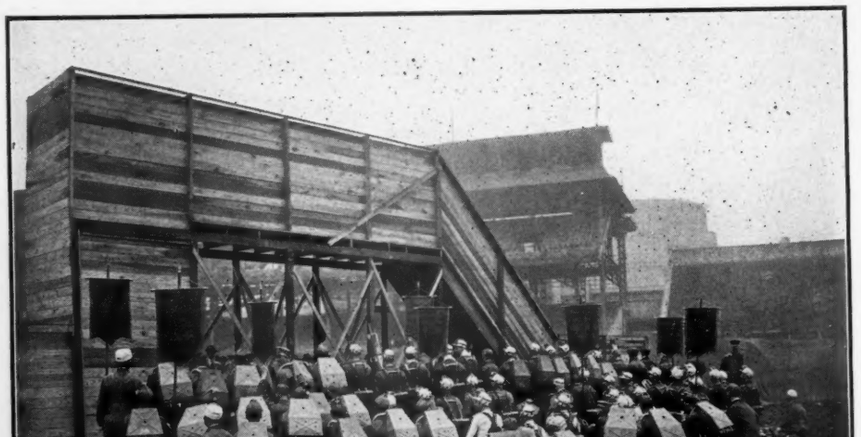
The miners' occupation being continuously filled with hazard, the rescue and first aid teams at the mines are looked up to as the leaders in a great cause and there is much local and regional pride in the proficiency of their men. The teams that come back from the Bureau of Mines contest with some of the honors are greeted as conquering heroes by their communities and are considered by their fellow-miners as far greater than the winner of a great athletic contest, for to the other men these men typify the greatest of heroes—the man who risks his life for his fellowman.

It is a little more than ten years ago that the Bureau of Mines, under the late Joseph A. Holmes, its first director, introduced into the mines a new method in life saving—the use of oxygen rescue apparatus which permits trained rescuers to enter a mine filled with poisonous gases that would kill in an instant. That allowed the formation of mine-rescue crews at the mines, and today there is not an important mining community that does not boast of its expert crews of life savers. If there are mines that have not yet sensed the forward movement, and disaster occurs, there are several expert crews at surrounding mines that respond to the call of disaster with all the eagerness of the heroes of song who man the life-boats when the storm is raging and life hangs by a slender thread. In fact this movement has grown so rapidly that it is said, in the event of a great disaster, a train traveling forty or fifty miles in a mining region can pick up more than sufficient expertly trained life savers to take care of the emergencies, no matter how great.

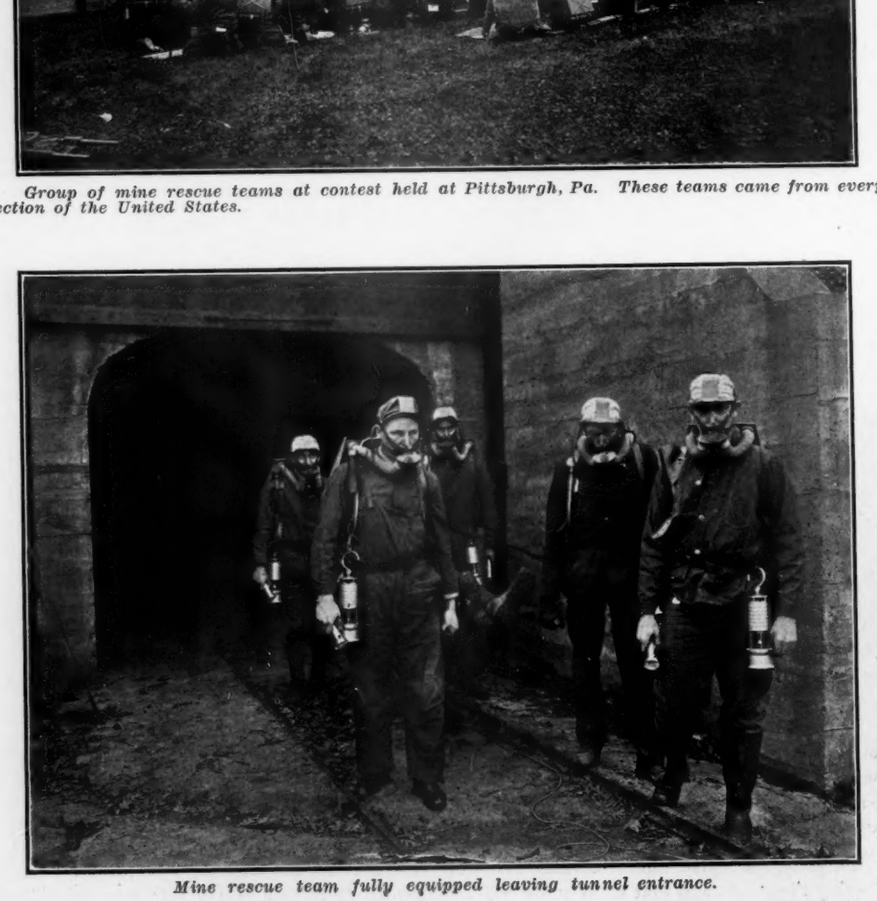
With the advent of the trained rescue miner, wearing the oxygen rescue apparatus, has come the trained first-aid man who takes the victim of a mine disaster and gives him the emergency aid that oftentimes is the difference between a dead miner and a live one; the difference between a man disabled for life and one restored to the full use of his powers; and the difference between a man deprived of his earning capacity and one who can support and protect his wife and children in comfort.

Today there are more than 100,000 men in this country trained by the Bureau of Mines in modern first-aid or mine-rescue work or both, all of them volunteers, ready to help their own or those in some other place, no matter where, for there is no distinction in the saving of the life of a fellow-man.

There is perhaps no other industry in the United States that has such hazards; there is no other industry that has such help from the Government. The Bureau of Mines maintains in this work ten fully equipped mine-rescue cars with trained rescue crews that visit as many mines throughout the country as they can, training men in modern life saving, and now and then stopping their work to rush to a disaster and assist in a practical way in the saving of men from death. The bureau also maintains ten mine rescue stations and five mine rescue trucks that perform similar duties. In this work altogether the bureau employs fifty trained mine rescue men.



Group of mine rescue teams at contest held at Pittsburgh, Pa. These teams came from every section of the United States.



Mine rescue team fully equipped leaving tunnel entrance.

Type of apparatus carried on back of body.

The mining industry in this country employs more than a million men, and more than 3,000 are killed each year while at work. This life-saving work has now been in existence ten years or more, and the records of fatalities show that in that time the lives of 5,000 men have been saved. To state this in another way, had the fatalities been in the same proportion the last ten years as in the preceding ten years 5,000 more miners would have lost their lives.

There is such interest among the miners in these contests, teams in the various mining states have been busy all the summer in local and state contests preparing through competition for the big events. Such states as California, Kentucky, Alabama, Indiana, Oklahoma, Virginia, Iowa and West Virginia have all held meets and selected their best teams for the Denver meet. The Lehigh Valley Safety Division of Pennsylvania recently held a "No Accident" week and picked out the best teams in their localities to attend the contests in September.

Last year the contests of the bureau were held at Pittsburgh, Pa., with 108 teams participating. This year the entries closed August 26, and were filed with the bureau at its Pittsburgh office. D. J. Parker, head of the rescue service of the bureau, will have charge of the meet.

One of the spectacular events will be an actual demonstration of the utility of the airplane in rescue work in quickly transporting engineers and oxygen rescue apparatus to the scene of mine disasters. While the mine rescue teams are showing their proficiency on the field where the contests are to be held, an alarm of a supposed mine disaster will be telegraphed or telephoned to the location of the nearest airplane of United States Air Service. An airplane will be immediately dispatched to pick up Bureau of Mines men and apparatus, bringing them to the field as quickly as possible. So many of the miners in the United States have been trained in rescue work by the bureau, it is not thought there will be much difficulty in promptly obtaining rescuers at a mine accident anywhere. The airplane will then be used in bringing to the scene engineers who have ability to direct rescue work.

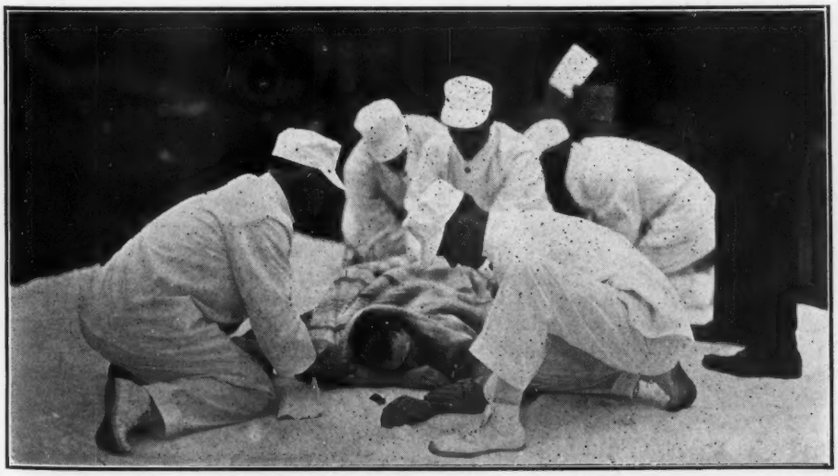
Another feature of the meet will be the formal presentation of gold medals to miners for deeds of bravery in saving life in the United States during the last three years. The awards will be made by Dr. Frederick G. Cottrell, Director of the Bureau of Mines, in behalf of the Joseph A. Holmes Safety Association, of which he is also president. The gold hero medal is to be presented to four western miners and to the nearest living relative of three others, who sacrificed their lives in their attempts to rescue fellow miners from death.

The men who performed deeds of bravery are: John L. Boardman of Butte, Montana, safety engineer of the Anaconda Copper Company; Daniel Bionvitch, Biwalik, Minn., an employee of the Balkan Mining Company; James Collins, Mullen, Idaho, an employee of the Gold Hunter Mining and Smelting Co.; and James Dilimark, Mullen, Idaho, an employee of the Gold Hunter Mining and Smelting Co.

Type of apparatus carried on front of body.

Three other heroes, miners for the North Butte Mining Co.; at Butte, Mont., sacrificed their lives in trying to save others. The nearest living relative of each of the three men will be at Denver during the First Aid and Mine Rescue Contest and will receive from Dr. Cottrell the gold medals and diplomas detailing the heroic deeds of the dead men. The men who died are : Michael Conroy, Peter Sheridan and John D. Moore.

That the meet will cover the entire mining industry of the country is shown in the number of teams already entered, such as the Homestake Mining Co., Lead, S. D.; Lehigh Coal and Navigation Co., Lansford, Pa.; Keystone Coal and Coke Co., Greensburg, Pa.; Hailey-Ola Coal Co., Haileyville, Okla.; Union Pacific Coal Co., Rock Springs, Wyo.; H. C. Frick Co., Pittsburgh, Pa.; United States Fuel Company of Indiana; State of Kansas First Aid Association; Temple Coal Co., Luzerne, Pa.; St. Louis Rocky Mountain Pacific Coal Co., Raton, N. Mex.; Colorado Fuel and Iron Co., Pueblo, Colo.; Huntington team of the Arkansas Mine Rescue Association.



Showing a first aid team in action administering treatment to a subject during Bureau of Mines First Aid contest.

The high premium says an English contemporary on the American dollar more than offsets the tariff; hence our manufacturers can send goods into the U. S. A. more advantageously than they can sell them at home, while the same premium on the dollar practically prohibits American manufacturers from selling abroad when there is any sort of competition from countries whose exchange is lower. The fluctuations in exchange also introduce a speculative factor which compels U. S. A. manufacturers to put on a larger percentage of profit to offset any change in exchange which may occur between the booking of an order and its delivery.

DESOUTTER DRILL UNDER TWO POUNDS WEIGHT

THIS DAINTY little pneumatic tool is an English product described in a recent issue of *Machinery*, London. As here shown it weighs 1 lb., 14 oz., and takes drills up to ¼ in. It goes without saying that its production represents high class workmanship throughout. The design is ingenious and requires careful study for a clear understanding of construction and operation.

The motor, Fig. 1, consists of a block of five cylinders, 7-16 in. bore and allows a stroke of 1⅛ in., arranged symmetrically around a central axis. The piston for each cylinder, Fig. 2, is hollow and working faces are cut on the lower end to fit a specially designed cam. The faces or slides on the pistons are cut spirally on a special machine.

The cam, Fig. 3, is a single piece comprising the conical extension for the drill chuck, the central member of the ball race, the double spiral working face which produces the rotary motion, a groove the purpose of which is explained later and a keyed drive for the valve. This cam rotates about the central axis, partly inside the recessed portion of the cylinder block. The pistons are operated in succession, a rotary distribution valve controlling the air. On the downstroke, which takes place while the pistons are on the left hand spiral side of the cam, the cam will be given a rotary motion in the usual direction for drilling. The pistons on the other, or right-hand, spiral face will at the same time be pushed upward, the exhaust also being controlled by the distributing valve, Fig. 6. The valve works on the circular valve face in the center of the cylinder head, Fig. 11. As each piston reaches the top and bottom of its stroke the valve functionally admits air in the first case, and permits the exhaust to take place when the bottom of the stroke is reached. This occurs with each cylinder in succession. There being five cylinders and pistons a continuous motion is thus given to the cam. At the bottom of each stroke two small ports are exposed in each cylinder, which allow oil to be blown on to the cam face and ball race. The purpose of the groove previously referred to is to accommodate a pin protruding from the extension of each piston. If the drill is rotated by hand these pins cause the pistons to follow the contour of the cam. If the pins were not there the pistons would be left at the top of the stroke.

The Desoutter Pneumatic Drill.

All the Parts of the Drill.

The cylinder head, valve face, inlet and exhaust ports are all in one piece, shown in Fig. 11. The only working parts of the rotary valve are the actual distributing faces, and the wear on these parts is minimized by the special device described later. As explained, the valve works in the cylinder head, and uneven wear is prevented by making it integral with a long stem reaching the length of the cylinder block. The lower end of the stem is a sliding fit in a sleeve which is keyed to the centre of the cam. The drive from the sleeve to the valve stem is through a mechanical lifting device which is balanced by the pressure on the valve, and this reduces friction on the valve face and consequent wear.

The cam rotates in a large ball bearing of which it forms the central member. Two large diameter outer races, fitted with balls of ample size, complete the essentials of the bearing, which hard practical testing has proved to have an ample margin of strength and wearing qualities for the work demanded of it. The thin steel ring, Fig. 5, is a distance piece clamped between the outer races, and forms the only adjustment required. These are in thicknesses varying by 0.0005-inch, and if the bearing requires adjustment a thinner or thicker one is put in as the case may be. Thus it will be seen that the race can be taken apart and put together again with a minimum of trouble and no risk of mal-adjustment.

The internals of the drill are kept in place by the screwed control valve housing, Fig. 9, and the screwed disc, Fig. 10. These screw at the top and bottom of the steel casing respectively. The conical end of the cam protrudes from the lower end of the drill, and is fitted with a No. 1 Jacobs chuck. This is kept on by a taper-fit and screw.

A very important factor in the efficiency of the drill, as far as air consumption is concerned, is the arrangement of employing one valve to control five cylinders, thereby reducing leakage to a minimum. Loss of air is also prevented by having the valve ports directly on top of each cylinder. Friction on the valve face is reduced to an insignificant amount by the balancing device elsewhere described. Another important point is the fact that the specially shaped cam gives a longer effective piston stroke than can be produced by a crank.

It will be readily observed that the form of construction of the cylinder block presents a means of getting the maximum power in the smallest space practicable. As they lie together the cylinders, of course, do not occupy anything like the space of a motor of the projecting cylinders type, nor is there any wasted space.

The first experimental model of this drill after a year's hard use, showed no signs of wear on the cam or piston slides and circumferential wear on the pistons was not discernible. The control valve is of the slide valve type, controlled by a push button. The rod of the press button acts as a piston, working through a small leather gland, the working pressure being used to force this outwards, thus automatically closing the control valve.

The drill has been developed and is manufactured by Desoutter Bros., Ltd., 51 Baker St., W. I., London.

The best drilling record in California oil fields is claimed by James F. Ross, drilling contractor of the Cement, Okla., field. He drilled 4,000 feet in 27 days, 148 feet per day, completing a job that the operators expected to last for at least 90 days. Ross netted $22,000 on the contract.

Dehydration of grapes is a new industry that is coming to the fore since the reaction of the prohibition laws against wine grapes.

PNEUMATIC TIE TAMPING TO REPLACE GROUTING

THE FOLLOWING report was rendered recently by the city engineer, Los Angeles, to the Board of Public Works:

Regarding Communication No. 19729 from the Los Angeles Railway Corporation stating that they have discovered that the cement grouting of the rock ballast under their ties very considerably increases both their capital investment and their cost of maintenance, and is also unsatisfactory on account of its rigidity, as it causes wear both on the rails and on the rolling stock, and that therefore they request that in the construction or reconstruction of all tracks on their system they be allowed to omit the grouting of the rock ballast, as they believe that they will be able to construct a better track and for less money. I beg to report, as instructed by your Honorable Body, as follows:

I have conferred with the Railway Company's Engineers and have also inspected streets where the rock ballast was grouted, and also several streets where the ballast was not grouted, paying particular attention to the question of the alleged rigidity of construction with the use of cement grout. I find the street surface within the railway right of way over rock ballast that has not been grouted to be in good condition, and causing no inconvenience to the travelling public. On streets where ballast has been grouted the street surfaces are also in good condition. Regarding the condition of the rails on streets where the ballast has been grouted, I find that owing to the rigidity of the construction the steel has been corrugated to a greater or less extent and undoubtedly causes damage to the rolling stock as well, both as stated by the railway company.

By the use of the cement grout in the rock ballast, cost of maintenance is greatly increased, and the benefit derived from the said grouting to the general public is so slight that there seems to be no justifiable reason why the grouting should be insisted upon. Therefore I would recommend that the grout be omitted under the following conditions: That proper drainage be provided for in the subgrade wherever necessary by means of open joint tile drains; that the rock ballast be rolled by a heavy roller and *packed around the ties by means of compressed air driven tampers,* thus giving the ballast the proper stability, and also that a smooth street surface be maintained.

Stainless steel is being employed very largely in the manufacture of pump rods, valve spindles, valves and other parts which are exposed to contact with water, steam and other corrosives. The scientific-instrument trade is using it for drawing instruments and other precision tools and for surgical instruments. It is being manufactured into stair rods, saucepans and pans of varying shapes, fenders for the hearth, and even into pokers and garden implements; and butchers' rails, spikes, skewers, saws and other butcher-shop requirements are being made from it.

MINERS LEAD IN THE FIRST CIVILIZATION*

THE ANCIENT and honorable vocation of mining is of such remote antiquity that Tubal Cain, "the instructor of every artificer in brass and iron," may be considered quite modern. Iron came into use not earlier than 2000 B. C., which sets a definite chronological limit upon the blacksmithing activities of the famous early descendant of Adam. The Bronze (copper) Age had its beginning in Egypt about 4000 B. C.; but underground mining for flints began in Western Europe 10,000 years ago. For the making of their fine stone implements and other articles—the New Stone Age men were not satisfied with the flints that could be picked up on the ground, as their ancestors had been for 50,000 years, so they began to dig for them. They were the first miners. Eighty of their worn deer-horn picks were found recently in the tunnels of the flint mines at Brandon, England. Even the skeleton of one of these early miners has been found in an old flint mine in Belgium, lying beneath a fall of rock from the roof of his tunnel, with a deer-horn pick still clasped in his hands.

The first metal-mining was done by ancient Egyptians in the copper mines of the Sinai peninsula nearly 6000 years ago. The stopes, looking very modern, are still open, and on the walls are the inscriptions of the early miners. We have their copper chisels and moils—shaped like our tools of today—their clay canteens and heavy stone picks. Already those wonderful people had discovered the art of smelting ore. Only in recent years have metallurgists succeeded in devising processes more successful and efficient. The copper-bearing ores that they dug and smelted were chiefly turquoise containing about 3⅓% of copper oxide; a hydro-silicate of copper; and granite rocks bearing a small percentage of carbonate and hydro-silicate. The highest grade of ore was a hydro-silicate.

The First Core Drill

In the Pyramid Age, 3000-2500 B. C., the Egyptians invented a tubular drill, which worked on the same principle as our modern diamond-drill and produced a perfect core of hard rock. Presumably the drill was of copper, and was fed on its cutting-edge with something like emery-powder, just as those extraordinary craftsmen fed the long copper saws with which they sawed blocks of stone for their buildings and monuments. The shaft of the drill was revolved by hand by means of a crank at the top, the turning-motion being assisted by two heavy stone 'governors' swinging just below the handle.

The story of Egyptian civilization has been told a thousand times, yet the wonder of it grows with increasing knowledge. We of today owe much to Greece and to Rome—our civilization would scarcely exist but for them—but Egypt was thousands of years old and decadent before the Greeks had emerged from the condition of simple barbarism.

Egypt was the mother of civilization. From her all of the ancient peoples learned nearly all they knew. She gave to the world agriculture, irrigation, the domestic animals, fruits and vegetables, the alphabet, paper, ink, architecture, sculpture, painting, glass-making, goldsmithing, weaving, other arts and crafts of various kinds, the mining and smelting of ores, metallic tools and weapons, the calendar, the first knowledge of the stars, the art of building sea-going ships, tools, many useful mechanical inventions, the first moral precepts, the belief in immortality, and an elaborate and efficient administrative system. All of these things she had devised and largely perfected over three thousand years B. C.

The scientific and mechanical accomplishments of the 19th century, wonderful as they are, pale beside the achievements of the early Egyptians, since they *created* mechanics and the sciences. They had no teachers; civilization arose with them.

It is almost incredible that such progress should have been made—from barbarism to a high state of civilization—in the thousand years before the 30th century B. C., yet such is the conclusion of the authorities.

Egypt traded with the then known world and carried her knowledge and progress to many peoples. Some of her trading ships ranged the Mediterranean; others traded along the coasts of the Red Sea, carrying Egyptian products and bringing back spices, gums, ivory, gold, etc. About 2000 B. C. a great canal was dug from the Nile to the Red Sea, enabling ships to pass from the Mediterranean to the Indian Ocean.

Originally, in the early ice ages, when the Sahara was a fertile plain, the present valley of the Nile was a rough fault-plane in limestone, nearly five hundred miles long, through which an enormous river rushed to the sea. Gradually the river declined in volume and the gorge silted-up; morasses and lakes succeeded, alive with great game and waterfowl, which were hunted by the Old Stone Age savages. Gradually the marshes became alluvial plains, yearly enriched by the overflowing Nile. The hunters became herdsmen, domesticating the wild animals; then learned to plant crops, then to irrigate. Irrigation demanded a settled community-life, so villages sprang up; population increased, little city-kingdoms were formed; various arts and crafts had their beginnings.

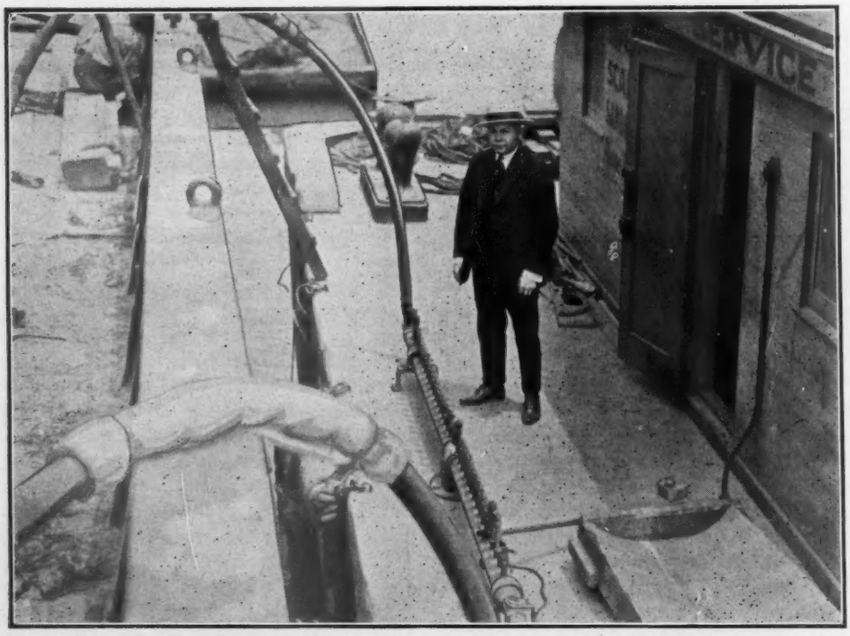
*Portion of article by Grant H. Smith in Mining and Scientific Press.

From a recent authoritative report it would appear that the available power of the Victoria Falls has been greatly exaggerated. The mean velocity of the river is about 700 yards per hour, or a volume of 704,970 cubic feet per minute. Taking 360 ft. as the head due to the actual fall, and adding the 20 ft. for the drop from the intake to the crest of the Falls, the total head available is 370 ft., assuming the turbines to be kept 10 ft. above the water in the cañon, and disregarding pipe-line friction. But if the turbine station is to be above flood mark, the available head will be reduced to 315 ft. Assuming an efficiency of 85 per cent. and a loss from pipe-line friction, the power available is about 263,000 kilowatts (352,420 horsepower) if the total volume of water estimated were used.

Chipping rust and paint from interior of ships without removnig timbers.

Paint sprayer operated by compressed air.

Barge equipped with sand blast can be towed alongside any steamer. This feature greatly facilitates operations and reduces cost.



Manifold on deck of barge. Note the twenty connections for one-inch hose lines which permits optrations to be carried on on a large scale.

COMPRESSED AIR EQUIPMENT DOES WORK OF 40 MEN

AN EXPERIMENT is being carried out on San Francisco bay in the use of compressed air and sand for chipping paint and rust from the interior and exterior of steel steamers. Two men directing two streams of sand against the steel are doing the work that formerly required 40 men to perform by the use of hammers for chipping. Not only this but the sand blast does a much better and more complete job.

The experiment proved so successful and the demand for this method of chipping became so insistant that The Martin Ship Service Company has installed the equipment on a barge, which can be towed to any steamer and work carried out without interfering with the loading or unloading of the vessel.

The barge has been equipped with a two stage air compressor of 500 cubic feet capacity, which is operated by a three cylinder Standard gasoline engine of 110-horse-power, operating at 250 R. P. M. The air pressure is maintained at 100 pounds. A large air tank is installed in the hold of the barge which is connected to two manifolds, one being placed on each side of the barge, on deck. Each manifold has twenty hose connections for one-inch hose, and two connections for two inch hose, which furnish air to the sand blast tanks. Two Pangborn sand blast tanks are used, which are usually located on the deck of the barge under the overhead sand supply hoppers, but in this case, the tanks were lowered into the hold of the vessel as shown in illustration. A special spout was arranged for delivering the sand to these tanks by gravity. One man is in charge of the sand blast tanks, and two men operate the nozzle. In this case it was unnecessary to remove the timbers from the ribs of the ship, in order to remove the paint and rust from the shell.

The barge carries 70 tons of sand in a hopper built in the hold, and by means of elevators is raised to the two overhead storage hoppers. Each of these overhead hoppers hold nine tons of sand, there being two overhead hoppers so that two grades of sand can be used.

Not only can the paint and rust be removed by sand blast but the vessel may also be painted by a specially designed paint spray operated by compressed air. This device consists of a receptacle holding ten gallons of paint, and an air line with a nozzle. The paint is atomized at the tank and carried through hose in a suspended condition to the end of the regulating nozzle. The nozzle is fastened to the end of a piece of pipe, the advantage of this being that the painter is not required to come into close contact with the atomizing part and also enables him to reach to a considerable height. Any kind of paint or liquid, thick or thin can be sprayed with equal ease. This method of painting is considered far superior to painting performed by hand as it is almost certain that paint will enter into and completely cover all surfaces, cracks or other indentations and at the same time give a much

smoother surface. There is less paint wasted and a much greater percentage applied than by the hand and brush method.

There are two generators one being used exclusively for generating electric current for lighting the barge, and a large generator for the purpose of generating electric current to supply a ship on which the crew may be operating. Long lines of wire are carried for this purpose. The generators are operated by the 110-h.p. gasoline engine, special clutches being provided for quickly throwing the generators in or out.

Two Pangborn sand blast tanks in hold of barges.

There is a complete pipe repair shop in the hold of the barge, where all repairs to the pipes, and equipment are made.

The barge is 90 feet in length, 35 feet in width and has a draft of only two feet. There is an electrically operated bilge pump which starts automatically when the water reaches a certain height in the bilge. This precaution must be taken for the purpose of keeping the sand stored in the hold perfectly dry at all times.

There is a special sand drying plant which is maintained on shore which supplies the sand for operation.

GAGING FINE CEMENT

Technologic Paper No. 48 of the Bureau of Standards, entitled "An Air Analyzer for Determining the Fineness of Cement," describes measurements made to determine the maximum sizes of particles passing through the 100 and 200 mesh sieves, as compared with the maximum sized particles blown off by the Nos. 1, 2 and 3 nozzles of the air analyzer.

In reporting results of tests, it has been at times desirable to know the maximum sized particles passing through the 330-mesh sieve. Therefore, 330-mesh sieve tests and microscopic measurements were made using standard fineness, samples 46/E and 46/F. The relation of the maximum sized particles passing the 100, 200 and 300-mesh sieves and the Nos. 3, 2, 1 nozzles of the air analyzer are as follows:

100-mesh	.00793
200-mesh	.00428
300-mesh	.00301
No. 3 nozzle	.00216
No. 2 nozzle	.00154
No. 1 nozzle	.00076

The above values are the mean results of two dimensional measurements.

Forty-nine pipes blown by compressed air controlled by player piano mechanism compose a new musical instrument.

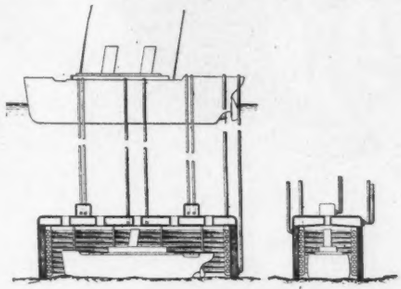
A SHIP-RAISING NIGHTMARE

SEVERAL WEEKS ago in preparing for our pages our usual list of U. S. patents having more or less pneumatic interest there was one which we did not recognize as in that class, and accordingly passed it by. The patent was entitled, "Apparatus for Raising Ships." There was the usual reproduction of one of the drawings pertaining to the patent and a copy of one of the claims, which read as follows:

"An apparatus of the character described, comprising a pontoon having an open bottom, and refrigerating means in the pontoon."

Now, who would ever have suspected that compressed air had anything to do with that? A copy of the patent complete, however, showed that we had been too hasty in rejecting it, for the device surely would not work without a lot of compressed air. If later we see also that it would not work *with* the compressed air detail, that is another matter.

To understand the apparatus and its operation it is to be assumed that the ship to be raised stands in normal verticality upon a level ocean bed, as sunken ships generally don't. Then a pontoon is to be constructed big enough to enclose the entire ship—say the Lusitania—and to drop over it leaving a considerable space all around. This space is very necessary because the interior of the pontoon is to be surrounded with coils and coils of refrigerating pipes in which brine or other refrigerant is to be circulated. The height of the interior of the pontoon is of course to be great enough to have room for such parts of the ship as may stand up in the way.



Patent Drawing of Ship-Raising Apparatus.

As to how and where this pontoon is to be built and then floated or otherwise conveyed to the precise location and then placed in the desired position to completely enclose the ship, please don't ask us to go into detail. We assume here that the pontoon is properly placed as shown in the cut and ready for business. The first operation will be to start the refrigerating plant and freeze the entire liquid contents of the pontoon—salt water at that—into a solid mass of ice. The refrigerating plant is of course supposed to be in the ship shown in the cut, but in fact, the way our imagination figures it, a refrigerating plant would be required probably as big as any in the world today. But that is a mere detail. Well, when the pontoon is entirely filled with ice instead of water, the ice being notoriously the lighter, it will have a tendency to rise and bring the ship with it; but it will be only a tendency, and that was anticipated. On the top of the pontoon are seen a number of enclosed chambers into which compressed air is now forced, and if these chambers are big enough, say four hundred and fifty times as big as in the sketch, they are bound to raise the pontoon, the chunk of ice and the ship frozen in it.

And now we come to the really funny part of it. The specification says: "When the pontoon with the block of ice therein and the sunken ship frozen in the ice reaches the surface of the water they can be towed to a place of salvage."

But, supposing the thing to work as described, as soon as the least little bit of the air receptacles emerge above the surface of the water the lifting effect ceases and nothing will be raised any higher. According to the sketch the top of the ship's smokestack will still be several feet below the surface of the water. The ship in fact will not have been raised in the sense properly understood, and the United States will have allowed a patent for an impossibility, both theoretical and practical. The only thing actually and satisfactorily lifted would seem to be the fee of the patent solicitor, of which he should be proud.

SPONTANEOUS IGNITION TEMPERATURES

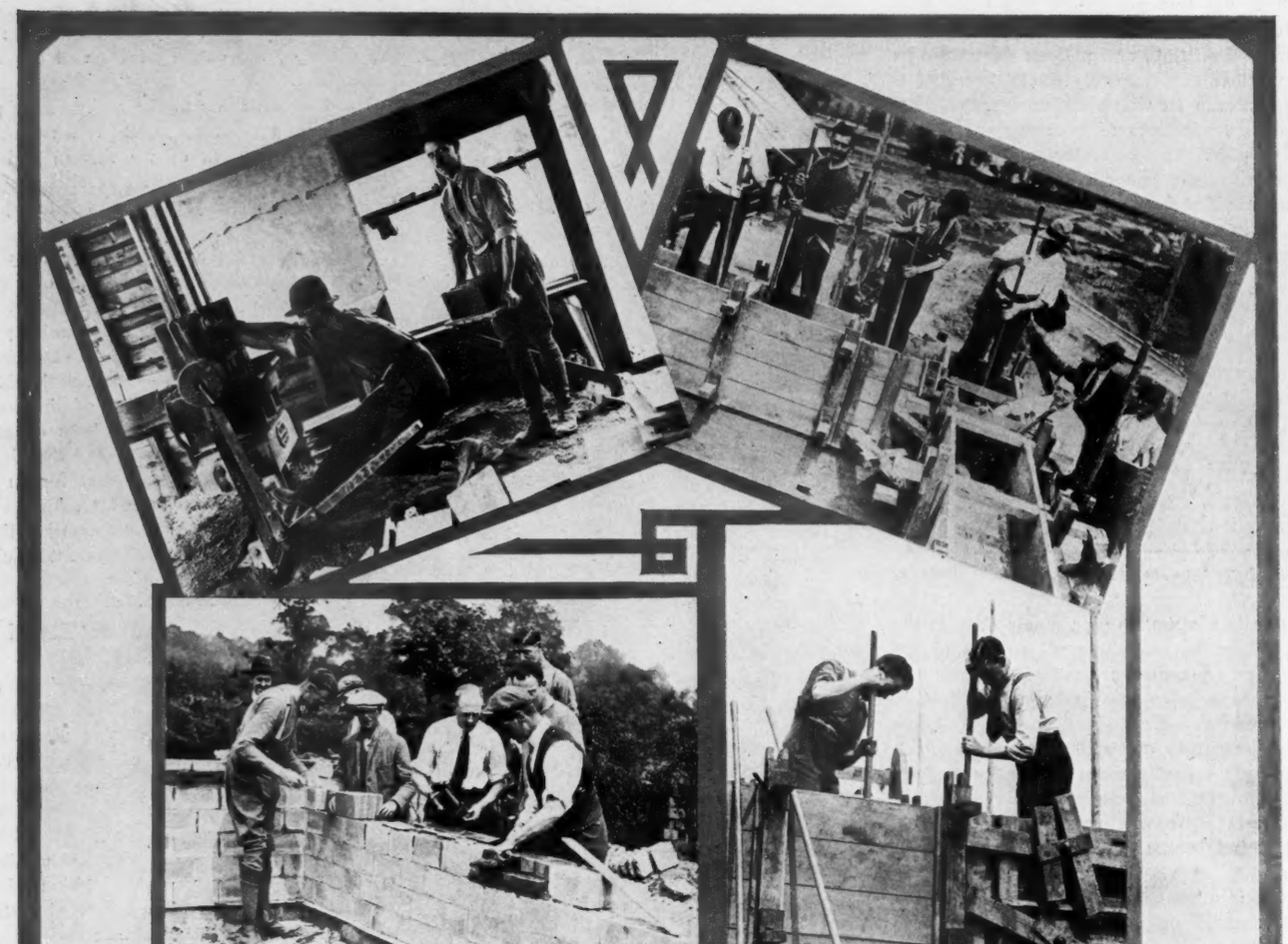
A BRITISH firm, Mirrless, Bickerton & Day, a few years ago carried through in their laboratory a series of investigations on the ignition temperatures of different combustibles, and from them obtained a lot of useful data especially valuable in the study of internal combustion engines of the Diesel type which depend upon the temperatures produced by high compression for the ignition of the charge. The following is a tabulated abstract of some of the results obtained:

	Spontaneous ignition temperature in oxygen	
	Deg. C.	Deg. F.
Gasoline No. 1	272	522
Gasoline No. 2	270	518
Kerosene	252	486
Gas Oil	254	489
Petroleum Fuel Oil	260	500
Shale Oil (Broxburn)	253	487
Tar Oil	470	878
Coke Oven Tar	494	922
Water Gas Tar	464	867
Blast Furnace Tar	498	928
Whale Oil	273	523
Naphthalene	402	756
Alcohol	395	743

From these figures it will be noted that the tars and tar oils have much higher spontaneous ignition temperatures than petroleum oils. This means that a degree of compression which will raise the compressed air to a sufficient temperature to ignite petroleum may be insufficient for tar oils—hence engines of the spontaneous ignition type working on tar oils should have either higher compressions or some other means of raising the temperature of the air.

About 4000 employees of the great Tata mills in India went on strike, demanding a special bonus because of an announcement that Sir Doradji Tata, head of the concern, had been presented with a son. It appears that the announcement was incorrect, but the workers refused to believe it, and decided to continue the strike and hold out for the bonus, son or no son.

A Return of Earthen Homes in England and America



© Photographs by Kadel & Herbert and Underwood & Underwood.

Fig. 1.—The apparatus for compressing moist earth into "bricks" for use in the novel scheme for making cheaper houses at Hornchurch, England. Ex-officers and men are there being taught to become practical instructors in order to extend the scheme throughout the country. Fig. 2.—Ex-officers ramming the earth into frames for the foundation. Fig. 3.—Ex-officers and men building a wall of earth bricks at Hornchurch. Fig. 4.—This picture shows two ex-officers ramming down earth between "shutters." The whole framework of the house thus becomes one individual "stone."

THE JUNE ISSUE of the COMPRESSED AIR MAGAZINE contained a leading editorial describing the experiments abroad, and in this country, in building houses of the material the British call "cob" and which is known in France as *pisé-de-terre,* or rammed earth. The editorial article to which we refer attracted widespread attention in this country and abroad and was responsible for the undertaking of capitalists in New York to form a housing syndicate for the purpose of constructing beautiful, permanent and model homes, somewhere in the vicinity of the greater city within easy commuting distance, to be sold at moderate price to folk who are feeling the pinch of high rents in the metropolitan area. At this writing this project has not yet come to fruition, but metropolitan dealers are hoping that it will be successfully consummated.

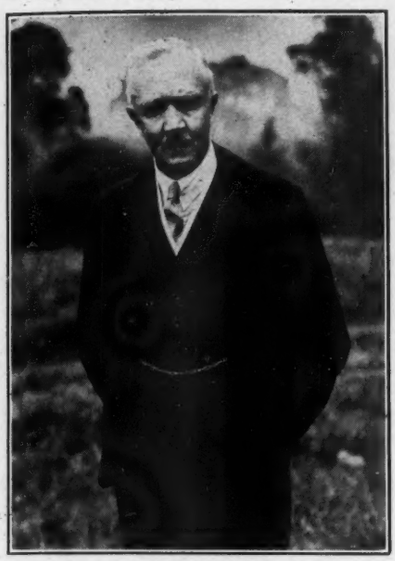
Meanwhile a Los Angeles contractor comes forward and says that instead of having a shortage of building material, at even the sky-high prevailing costs, we have a plentiful supply of the very best. These earthen houses should not be confused with *adobe.* The *adobe* house is built of sun-dried bricks, whereas the earthen house, which we described at some length as to its construction in the editorial in our June issue, is built of clayey earth containing a binder of straw or hay, and is rammed tightly in molds similar to those used in concrete house construction, or is made in forms as large bricks under pressure. The suggestion has been advanced that these houses should be built with sand rammers operated by compressed air and that their exterior surfaces should be coated with gunite by means of a cement gun. While the *pisé* houses of France have been standing for a century or more and are still in excellent condition, it is believed that with the thin cement covering on the exterior they will be better to withstand the effects of weather and can then the better receive a coat of whatever color the builder prefers.

There is nothing new about earthen houses, for ancient Ninevah and other cities of lesser antiquity were made of that material. The Bible tells of how the Israelites objected to making bricks without straw. The Mexicans of today, and for many generations past, have built residential houses of *adobe,* employing only their bare feet and hands in the process.

The best soil for the purpose contains clay which should have little or no sand or gravel mixed with it. Improvements made in the finish and sanitation of these houses have been

such that dampness is no longer among the troubles experienced.

The Los Angeles contractor referred to has constructed a "Magic White City" of 250 residences on the southern exterior of Los Angeles where people have watched the work with keen interest. The builder not only



General Maurice, chairman of the Exervis Syndicate (England) which is experimenting in the construction of cheaper houses made of earth only.

asserts that the houses are everlasting but declares that they are waterproof and fireproof and that they certainly cost no more than wood, if as much. Similar houses are being constructed in England at Hornchurch, Essex, by the Exervis Syndicate, of which General Maurice is the directing head. As its name indicates, the syndicate is composed of ex-service men and includes many officers who saw service in the great war. They believe they are conferring a distinct public benefit in their endeavors because of the prevalent lack of housing facilities, England and European countries having suffered in this regard quite as much, if not more, than America.

Former officers in the English army service who are learning this house-building method expect to establish schools to teach this means of building, and the officers seen in our photographs above are being trained to become practical instructors. COMPRESSED AIR MAGAZINE again wants to call attention to the fact that the economical way to build these houses in quantities is to employ the pneumatic-driven sand-rammer in the earthen forms.

During the eight years from 1911 to 1919 the amount of waste produced by the collieries of South Africa was reduced from 30 to 16 per cent. of the total coal mined. Recent statistics show that the waste now amounts to about one million tons annually.

Mexico is the only country in the world which has nothing but coin as a circulating medium. This condition has existed for three years—1916-17 to 1920.

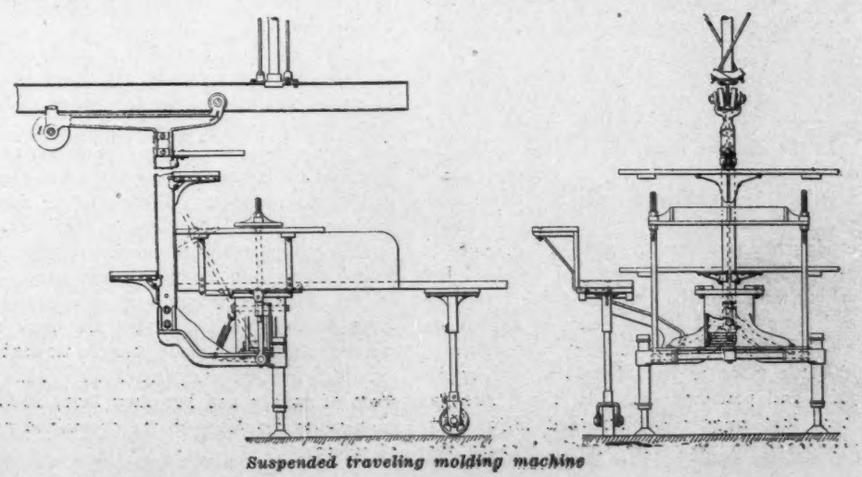
A SUSPENDED TRAVELING MOLDING MACHINE

THROUGH THE installation of suspended molding machines—84 of them—the Standard Malleable Iron Company, Muskegan Heights, Mich., has effected an increase in production of from 15 to 30 per cent per molder. The machine employed, shown in the outline cut here reproduced from *Iron Age*, was invented and has been patented by E. L. Howe, president of the company. It hangs upon and is easily movable along a rail which extends lengthwise over the molding floor. A single workman can move the machine by hand to any point on the rail, and through the adjustment of pneumatic-controlled legs can fix the device firmly in a stationary position regardless of the irregularities of the floor. The legs, it will be noted by referring to the line drawing, are in reality plungers fitted in pneumatic cylinders, and may be withdrawn or extended by admitting air to or releasing it from the cylinder chambers. When the molder wishes to move the machine he turns a stop cock to liberate the air from the cylinders. When he desires to place the machine in a fixed position, he turns on the air, thereby forcing the legs against the floor. The legs are fitted with concave cups which grip the sand under foot and insure the rigidity of the machine.

The Howe machine, in its simplest form is really a movable molding bench. Formerly when the benches in the company's foundry were situated at the wall end of each molding floor, the molder was forced to carry his work the length of the floor to the aisle, at the same time running the risk of shifting the molds. The suspended bench enables him to commence work close to the aisle, at the end of his sand pile, and gradually move toward the wall as his day's work progresses. Under this plan the molder places the mold on the floor directly behind him. The machine also enables the molder to handle all his own molds, even though large, whereas ordinarily a helper is needed to carry out the molds.

Another advantage of the Howe device is that the molder's afternoon work is not interfered with by the heat radiating from the sand. When the wall benches were in use the last sand dumped from the morning molds would be adjacent to the molder when he resumed work in the afternoon. In the summer output was often reduced because the men could not stand the increase in temperature due to the hot sand. The suspended bench, on the other hand, enables the molder to progress back to the wall, using up the sand as he goes, just as he did in the morning.

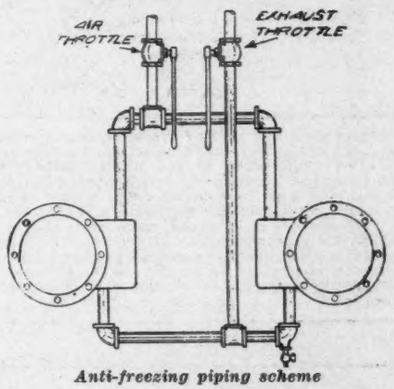
Among the benefits derived from the use of the machine is a marked saving in labor. Whereas the Standard company formerly employed 22 laborers and 22 molders for each 10-ton furnace, it now secures satisfactory work with sixteen of both classes of workmen. In the case of common labor which is paid by the day the use of the machine has resulted in a clear saving of the wages of six men per furnace. On the other hand, the molders, who are on piece work, have been the beneficiaries of the increase in output made possible by the suspended bench.



Suspended traveling molding machine

ANTI-FREEZING DEVICE

In a certain case where a duplex steam engine was driven by compressed air instead of by steam a novel piping scheme was adopted as shown in the sketch here reproduced from *Power Plant Engineering*. When the engine was running the throttle valve in the air pipe was left wide open and the air followed at full



Anti-freezing piping scheme

pressure as far as it could, the speed and power being entirely controlled by the throttle in the exhaust pipe. The air pipe was of course drained of all entrained water before the air throttle was reached. We are not informed as to the efficiency of the scheme, but we must assume that the results were beneficial.

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EDITORIALS

DEVELOPMENT OF SALVAGE METHODS, A NECESSITY

FULLY EIGHT billion dollars worth of ships and cargoes were either sunk or carried ashore during the World War—sacrifices nearly totalling the combined toll of marine disasters for the preceding period of a hundred years. No wonder the nautical salvor came into prominence and won a deal of credit for his daring deeds and fine achievements in connection with the saving of many ships and the refloating of quite 450 craft which would normally have disappeared in watery graves.

In the decades gone, the salvage of stricken vessels was commonly a business characterized by rough-and-ready practices, rule-of-thumb methods, that might rightly be called crude when measured by engineering standards accepted ashore. The men that followed the calling were mostly of the sea-going fraternity and were guided in the main by expedients which had helped them in many a predicament to battle more or less effectually with angry gales and pounding seas. It is not strange, then, that numberless imperiled ships were abandoned to their fate simply because the technique of the wreckers failed at the crucial moment.

It is true, here and there a man of engineering capacity appeared among the many salvage associations or companies, scattered broadcast the world over, but they were not a sufficient leaven to alter materially for the better the ways and means usually adopted among workers in this department of marine activities. And then came the time for collaboration when German submarines, especially, steadily increased their grim toll and brought their levy upon shipping to a startling total of some hundreds of thousands of tons each month. It was necessary to save every craft that might help to maintain the lines of communication over seas.

To this end, the British blazed the way by creating the Salvage Section of the Admiralty, recruiting a personnel from the most experienced and progressive of those familiar with the art and simultaneously creating flotillas of wrecking vessels equipped with every facility that might help to make more certain the recovery of ships and cargoes. By this service it was hoped to offset as far as practicable the distress occasioned by the Kaiser's ruthless sea asps. Thereafter, for several years, the waters about the British Isles, and later those washing the shores of France and Italy, became in effect one great marine laboratory, where trained salvors could operate without stint, without regard to cost, and use every medium that seemed to promise aid.

Accordingly, between the Fall of 1914 and the Spring of 1919, apparatus and methods were devised and brought into play upon a scale previously deemed commercially out of the question. Much was learned; and from this course of action—born of desperation—now stand out certain lessons of enduring value. We know to-day that the entirely submerged wreck is by no means a hopeless body to lift from the seabed and to carry suspended upon looped steel cables a distance of miles into shallow waters where simpler and well-known salvage practices can be used to refloat her. However, the future of marine salvage depends upon abandoning many of the practices of the past, in profiting by the up-to-date equipment to be had, and in recognizing that there is still plenty of room for betterment. In short, make marine salvage in every sense of the word a department of engineering.

If this be done, hundreds of ships that lie beneath the waves can be reclaimed and put in service again; and the cargoes of many of them would richly repay recovery, for contact with the sea water is not necessarily injurious or destructive to a vast array of marketable commodities. Elsewhere in this issue we deal at some length with what is feasible in the realm of marine salvage when technical efficiency is given a free hand. And of the wonders wrought in releasing ships from perilous positions none are more conspicuous than those made possible through the manifold uses of compressed air. This medium of energy and buoyancy lends itself by its peculiar flexibility to the diversified needs of salvage.

"POLITICS" AS AFFECTING OUR NATIONAL INDUSTRIES

POLITICS as a profession has fallen into such disregard, not to say disrepute, with the rank and file of the American people that lines of partisanship between the two major "old-line" parties visibly have been growing less definite. The manufacturer, the business man, the exporter, the shipbuilder, the financier—the latter particularly—are greatly concerned in the political pulse of the people.

Voters of America have been learning, by means of countless object lessons, that "playing politics" for the sake of a party name means nothing short of playing into the hands of a group of men in one party or the other, and that a very small group of men, comparatively, control the final results. We apparently do not elect a president in accordance with the wishes of the majority of the voters of the country. This was indicated by the Presidential poll undertaken at great expense by our popular neighbor, *The Literary Digest*, which counted millions of votes of people that took the trouble to express their preference in writing.

The man that received the greatest number of votes in *The Literary Digest's* poll, leading all the candidates of all parties, was not even able to get the nomination of his own party. The widely read weekly periodical that proved this deserves the thanks of all persons that desire to see their country well governed under the leadership of an executive elected in response to the popularly expressed will. It is no part of our intent to suggest a remedy, but consideration of the facts is again important in this Presidential year.

In essence, there appears today virtually no difference between the Republican party and the Democratic party, except in personnel of the political machinery of each. They merely constitute two opposing groups of political convenience. If one party puts in its platform a certain stand on a given question, the other party is pretty sure to insert in its *credo* a plank that is diametrically opposed to it. Only those living in the past of American political history believe that the two parties exist as standing for certain fixed principles. In the view of "forward-looking" voters, both parties represent merely expediency. One hears everywhere in the course of the Presidential campaign the thought expressed that Americans are growing more wearied and more disillusioned each year by politics as played in blind adherance to partisanship. This may, or may not, have been discovered by legislators and party leaders at Washington—the latter being the probability—but it nevertheless is an undoubted fact.

The Pullman car and the steamer are regarded as clearing houses of national sentiment. Travellers are drawn together and into the interchange of the ideas and opinions by the first instinct of travel, which is discovery. One seeks to learn his fellow traveller's views; to profit, perchance by his experience, by his observations, by his peculiar experiments in life's chemistry. Curiously enough, the mind that may be reticent at home, will often freely express itself when travelling.

We not long ago completed a trip that covered twenty states in the Middle West, Northwest, South and Southwest, and met and talked with all manner of folk ranging from great captains of industry to the workmen and workwomen in their ranks. On board trains we heard the most unusual and highly thoughtful sentiments expressed. We found men thinking nationally and internationally, instead of locally and in terms of racehorses, baseball, or even the dwindling topic of prohibition. On the latter head it is interesting to note that the great mass of the people have accepted prohibition, but still it is being made a political issue by those with purposes to serve.

A skillful woman golfer forgot her hobby in dissertation on the peace treaty and American policies. An expert mechanic who accompanies new steam locomotives to their points of delivery and puts them in service, dilated on the selfishness of politicians whose sole ambition is to maintain tenure of office at no matter what sacrifice of public welfare. Engineers, sales managers, mining men, manufacturers, salaried railroad men in responsible posts, all got around in conversation sooner or later to the moot topic of political tendencies and national economics as affected by them. All of them seemed to be simply aching for plain business-like conduct of governmental affairs, for dignity and horse sense in legislation.

It was enough to give pause to even the professional observer of all things affecting the healthy growth of industry. Our industries in America are so affected by politics as played by the partisan jugglers in legislative centres, that the whole people of the country are in no position to ignore political action or political tendency that affect those industries, for they are the well spring of our prosperity and well being, of our place in the world, of our present favored place in international economics.

It begins to appear that our people will presently demand that first of all the President shall be elected by direct popular vote, without primaries or party conventions controlled by an ultimate handful of men; and that next they will demand a national university or academy on the lines of the army and navy schools at West Point and Annapolis for the training of men for public life, whether in statesmanship, diplomacy, or plain to fancy office-holding. Such a school has been seriously debated among thinking people. In time no member of either house of Congress would be eligible for election unless he was a graduate of the courses it would afford in economics, business, international and fundamental national law, social relations, the science of government, and all those lines of thought which should be attained by the competent statesman. It would make a respectable career of office-holding and of "politics" leading to office-holding.

It is at least a scientific suggestion. We train men for the army and navy, but we do not prepare the civilian secretary who really takes command, under the President, of either of those branches of service. A man can be admitted to the bar of a state only after a course of study in the law and passing his examinations. Yet we elect men to our state legislatures who have no intellectual, humanitarian or educational equipment, and expect them to make laws for us to guide our civic destinies.

THE LUBRICANT AS A PART OF THE MACHINE

THERE IS still much to be said, and to be reiterated over and over again, upon the important topic of lubrication. The mechanical world has really come quite slowly to a full realization of its importance. The primeval mechanical devices, mostly of the lever type, did not involve rubbing or sliding surfaces and consequently no lubricant was needed. When more elaborate mechanical devices came to be employed, with wheels and shafts and what not, the lubricant still was not thought of, and so it seems to have been instinctive and habitual from the beginning to look upon oil or grease or other lubricant in connection with moving machinery as a mere afterthought and a handy assuager of trouble. When the wheelbarrow squeaked we would oil it, and then no more until it squeaked again. The writer hereof can remember a certain line-shaft in an old machine shop which received a squirt of oil at each hanger in the morning, and then no more until the next day unless in the meantime a journal got nearly red hot and gave out smoke and sparks, when there would be a shut down, a dosing with water and then a pouring on of oil by the canful.

"That tired feeling," when machines were driven by man power—and especially when driven by boy power—led in early days to the discovery that oiling a machine made it run easier, but even then the oil usually would not be thought of, and the habit of regular and systematic oiling was of slow development.

Today there can be no plea of ignorance as an excuse for the neglect of proper lubrication. It is a thing with only one side to it, and there is not the slightest chance for an argument. We have all sorts of data now as to the differences in power consumption with and without proper lubrication, which would all seem to be superfluous since we all are sufficiently informed along that line.

There are the days of the ball bearing and the roller bearing as necessary elements in machine construction. These are provided for in the design and construction of the machines where they are used and they become component parts of the machines. A ball bearing without the balls would be no more an anomaly than would the play of Hamlet without the Prince of Denmark. If for the performance of the function of the metallic balls the minute balls or globules of a liquid or semi-liquid are substituted, why should not these be as indispensable as the other?

It may be said that no tool or machine, however simple or complex, which has sliding or rotating surfaces in contact with each other can be regarded as complete and fully ready for work until every such surface has its quota of lubricant, and no machine which is intended to operate continuously can be accepted as complete unless provision has been made for a continuous application or a constant maintenance of supply of the lubricant upon the surface requiring it, and the builders of such machines cannot be said to have fully completed their work of construction until they have provided the means necessary for such lubrication, because the lubricant must be regarded as a necessary and actual component of the running machine.

ENGINEERS PERFECTING A NATIONAL ORGANIZATION

THE RECENTLY organized Federated American Engineering Societies which is a successor to the existing Engineering Council is carrying on the work of the Council in a much more extended plan as to scope and membership. The object of the new organization as declared in its Constitution,

"Shall be to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common concern to the engineering and allied technical profession."

Recently, the engineering profession has become aware of the need of cooperation between the different branches and the necessity of having some well organized central body so constituted that concerted action can be taken upon questions of the day and present the engineering viewpoint.

The time was and not so long ago either, when the engineer held himself aloof from other classes of his fellows and refused to unbend from his professional dignity to enter into any prevailing discussion. The natural result of such practices was illustrated by an incident which occurred in connection with the proposed building of a vehicular subaqueous tunnel to connect the commonwealths of New York and New Jersey.

It seemed that the matter was under consideration by the Bar Association of New York City, the leading and authoritative body of the legal fraternity. As a matter of fact, the engineering societies received a request from the foregoing legal body to appear before them and show reasons for the construction of such a tunnel. It would seem only consistent that the engineering organizations should take just as active and vital an interest in such a great engineering project without the instigation of their legal brethren. The incident, of no great importance, is significant of the need of engineers taking part in all public questions. It is only good patriotic citizenship. It is an obligation of the individual engineer to his country.

So the Federated American Engineering Societies was particularly happy in interpreting the object of the society, when it said in a recent announcement that the purpose of the organi ation is service, first to the nation, state and community, and second to the profession which obviously must include the interests of the individual.

While it is true that it does not deal with the interests of the engineer and technologist as does a labor union for its member, nevertheless its work will do more ultimately to

advance the interests of the individual than a labor union could possibly do, because the advancement of the profession through a greater recognition by the public of the engineer and allied technologist and the greatly increased solidarity and higher standards of these professions must unquestionably work for their ultimate good.

THE NEW COMPRESSED AIR TREATMENT

DIFFERENCES of air pressure undoubtedly have their effects upon the functions of the human body. Some of these effects, when complicated by other conditions, may not be altogether beneficial while others may be, and in this connection there would seem to be opportunity for profitable investigation.

Lesser atmospheric pressure, with probably sufficient range, may be obtained simply by changes of altitude, and of these and their effects much information has accumulated, with in addition our recent aviation experiences, but little has developed concerning the physiological effects of air compressed to higher pressures except in deep mining and in tunnel and caisson work where other accompanying conditions have been undesirable and the air pressure has been regarded as simply an unavoidable evil to be tolerated and made the best of.

Dr. O. G. Cunningham, of Kansas City, as narrated in the July issue of COMPRESSED AIR MAGAZINE, was not satisfied to let it go at that and accordingly has gone to work to seek positive good effects in the treatment of certain of his patients by subjecting them to air pressures higher than normal.

It is gratifying to know that good reports are being given out concerning the success of the doctor's experiment. With an absolute pressure double the normal, or say 15 lb. gage, the quantity of oxygen per volume inhaled by the patient is also doubled, and it might have been predicted as reported that "the immediate effect of the treatment is an enormous stimulation of energy with also an increase of appetite, a quieting of the nerves and restful sleep."

These reports concerning the results of a novel experiment have to be taken for what they may be worth, and we could not be disposed to depreciate them, at the same time, when we come to think of it, we must realize that the good doctor has undertaken something of a job. We are not informed as to the compressor capacity in connection with his installation. It is necessary to remark that no little dinky compressor sufficient to produce and maintain the desired air pressure could be of any use. A compressor of large capacity is needed to maintain not only the required pressure but also a constant flow of fresh pure air at that pressure.

From the article "Ventilation" in *Encyclopedia Britannica* we learn that hospital patients are allowed 2,500 cu. ft. of fresh air per hour. With the pressure doubled the doctor should provide 5,000 cu. ft. of free air per hour, or 83 cu. ft. per minute per patient, and for 72 patients to be treated at once would call for almost exactly 6,000 cu. ft. of free air per minute. This certainly would call for a large compressor, and to distribute the air within the small space provided without uncomfortable drafts would require much ingenuity. Then the temperature of the air delivered should be controlled with absolute precision while we know that it would come from the compressor too hot for use. Special aftercooler arrangements might, with sufficient ingenuity, be provided to satisfy the case, and then there would be only the humidity of the air to be looked after, but this also under the circumstances would be another complication of a problem all the details of which we cannot attempt to discuss here.

In pointing out these things we should not be misunderstood. We would greatly rejoice over the success of this compressed air experiment, and we fully believe that it is possible to produce most gratifying results in this line, but nothing permanently satisfactory can be accomplished if the imperative conditions which we suggest are ignored. R.

A recent despatch from Santiago, Chile, states that sales of from 600,000 to 800,000 tons of nitrate for future delivery at a price averaging 17 shillings per cwt. have been accompanied by a notable rise in Chilean exchange.

Contents for September

Modern Marine Salvage and its Potentialities—*Robert G. Skerrett*..... 9777
Crude Rubber—Its Production and Uses—*Richard Hoadley Tingley*..... 9787
Personal Intelligence 9790
Getting Best Results From Rock Drill Bits—*Walter E. Carr*..... 9791
Vacuum Storage Tank. *E. F. Creager* 9792
Air Proves Useful in the Paper Mill.... 9793
Stiff Hats to Protect Heads of Miners—*C. Lorimer Colburn*..... 9794
Varieties of Wire Rope in Cross Section 9794
Air Machinery Exports from United States 9794
Research Plant for Investigation of the Air Lift—*Eugene P. McCrorken*.... 9795
Desert Engineering Feats Shame Alladin 9797
The Use of Higher Air Pressures Proposed 9797
The International First Aid and Mine Rescue Contest—*E. J. Bailey*..... 9798
Desoutter Drill Under Two Pounds Weight 9800
Pneumatic Tie Tamping to Replace Grouting 9801
Miners Lead in the First Civilization.... 9801
Compressed Air Equipment Does Work of 40 Men 9802
Gaging Fine Cement..... 9803
A Ship Raising Nightmare..... 9803
Spontaneous Combustion Temperatures.. 9803
A Return of Earthen Homes in England and America 9804
A Suspended Traveling Moulding Machine 9805
Editorials 9806
Development of Salvage Methods, A Necessity 9806
"Politics" As Affecting Our National Industries 9806
The Lubricant as a Part of the Machine.. 9807
Engineers Perfecting a National Organization 9807
The New Compressed Air Treatment.... 9808
Book Reviews 9808
Seven Centuries of Brass Making..... 9808
One Pound of Motor Per Horse Power.. 9809
Notes of Industry..... 9809

Book Reveiws

SEVEN CENTURIES OF BRASS MAKING, a brief history of the ancient art and its early (and even recent) method of production—contrasted with that of the electric furnace process. A company treatise published by the Bridgeport Brass Company of Bridgeport, Conn.

A BEAUTIFUL PIECE of book-making has been issued by the well known Bridgeport Brass Company; it describes the ancient art of brass making from its ancient beginnings down through its various developments to the most modern achievements of the twentieth century. Aside from the real excellence of the text, and its excellent literary style, the book is a fine specimen of the typographical art.

This treatise, of which every metallurgist will be glad to have a copy, and which we daresay, can be obtained free of charge by writing to the company, indicates that the metallurgy of copper, tin and iron was practised in its crudest form in the earliest periods of man's development. Of these three metals, copper, on account of the ease with which it is smelted, refined, and worked, was probably the first to be used. There is no definite proof of this, except that as far as historic times are concerned, copper and bronze were in common use long before iron, though iron was known. In the July issue of COMPRESSED AIR MAGAZINE, was published a review of the volume entitled, *The Modern Development of High-Speed Tool Steel,* issued by Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., of London, in which it was declared as generally accepted that the first iron used for tools was of meteoric origin. In other words, the users of iron in ancient times did not mine it out of the earth, but obtained it from meteorites which had fallen on the earth from the skies.

The "Historic Notes" given in the Bridgeport book declared that neither the name of the man who discovered the reduction of copper by smelting nor the method he employed will ever be known, because he lived long before men began to make records of their discoveries and doings. There are, however, some evidences of prehistoric metallurgy in the many "founders' hoards" or "smelters' hoards" of the Bronze Age which have been found in western Europe. These hoards indicate that in those days charcoal and ore were burned in a shallow pit in the ground and that the fire continued until the copper was melted. It was then allowed to cool in the bottom of the pit, forming a rough, round cake from eight to ten inches in diameter.

Another indication of prehistoric metallurgy is the fact that copper from this period, analyzed by Professor Gowland and others, shows a small percentage of sulphur, signifying that the copper was derived from smelting oxidized ores. The book takes us through the Egyptian period of copper development dating back to the fourth Dynasty from 3800 to 4700 B. C. The crucible is the Egyptian emblem of copper, which would indicate that it was used for refining.

The early history of brass itself, our authority declares, is much beclouded on account of the fact that brass is often confused with bronze and other copper alloys. There are many references to brass in the Bible, which

are undoubtedly due to faulty translation, either bronze or copper being meant.

It would deprive prospective readers of real pleasure to attempt to summarize the historical tale of brass, brass literature, brass making in the Middle Ages, the skill of the early master founders, and the beginnings of brass making in the United States.

The Historical Notes are followed by a practical treatise on modern brass making, describing mill practice from beginning to end, and treating on the difficulties of brass making; the possibilities of the electric furnace, and what is done in our up-to-date casting shops.

We heartily commend this book to all of our readers who are interested in metallurgy, and in so doing we are glad to pay tribute to the work of Messrs. Ray D. Lillibridge, Inc., of New York, who wrote and supervised the production of this fine piece of work. *F. J. T.*

EXPORT TRADE AND EXPORTERS REVIEW, the little weekly magazine for exporters and manufacturers published at New York, contained in its issue of June 12, this year, an excellent article by Mr. Walter F. Wyman, Sales and Export Manager of the Carter's Ink Co., of Boston, on *The Place of the House Organ in Export Selling*, showing why the house journal should be edited for the reader and not for the editor. Every American manufacturing house that is an exporter of its own products should not fail to consider this excellent treatise.

The American International Corporation's *Argosy* for June contained an article reviewing the work of the first years of the American International Corporation's research department. This article is illustrated with an organization chart of the department showing how the work, tabulating information, routing it and making the best possible use of it, is carried out.

A paper entitled, *High Spots in the Observation of South American Railway Conditions*, by John P. Risque, was contained in the official *Proceedings of the New York Railroad Club* under date of May 21. It is one of the most interesting South American transportation articles that has ever come to our attention. Every business man who has ever travelled in South America and every business man who proposes to travel there would do well to read this excellent description of rail transport conditions in the southern half of the hemisphere.

Industrial Power is a new magazine, dedicated to the conservation of labor and of the nation's resources, which is published monthly by the Maujer Publishing Co. at No. 538 South Dearborn Street, Chicago. It is distributed exclusively to buyers of mechanical equipment and is sent free to all interested business men. Mr. A. Maujer, a well known trade journal editor and advertising man, is at the head of this enterprise, the editor of which is Mr. I. L. Kentish-Rankin. Mr. Kentish-Rankin is a very able editorial man who has made his mark in the American trade journal field. The first issues of the magazine appeared this summer. In the July number there is a very fine article on *Human Engineering* by Gov. Henry J. Allen of the State of Kansas, in which he describes the Kansas Industrial Court, which has attracted such world-wide attention. Governor Allen will long be remembered for his famous debate in Carnegie Hall, New York, with Samuel Gompers of the American Federation of Labor, in which verbal tilt Governor Allen had much the better of the argument. Governor Allen succinctly describes the courts when he says that it is not a court for regulating anybody. "It is a court whose chief purpose is to protect the public against industrial strife by enforcing justice."

We do not know the editor of *Sinclair's Magazine*, but we know his name is Glen B. Winship, and we also know that he is publishing the most artistic house journal ever gotten out in the history of American business. *Sinclair's Magazine* is a joy to the eye and contains articles and illustrations so beautifully "done" that they constitute real literature and art. Every oil man in the country and every purchaser of oil in any quantity should get himself on the mailing list of *Sinclair's Magazine*.

ONE POUND OF MOTOR PER HORSEPOWER

THE HEAVIEST source of power in common use is animal power. A horse weighing one thousand pounds will develop eight-tenths of a horsepower for eight hours. For the continuous 24-hour development of one horsepower, 3,750 pounds of horse would be necessary. Man is a little better on that basis. Under favorable circumstances he can develop one-seventh of a horsepower for eight hours, which would give him a weight of 3,150 pounds per horsepower if the individual man weighs 150 pounds and develops power continuously.

The average stationary steam plant, including boilers, engines, condensers, chimney, and the numerous auxiliaries, the water in the boiler and the circulating water, has a weight which is high and extremely variable. All condensing steam plants must be heavy because of the necessity of carrying a large weight of circulating water. A modern locomotive develops about two thousand horsepower and weighs 300,000 pounds, giving a weight of 150 pounds per horsepower. This, of course, includes the running gear, which does not properly belong to the power plant.

It is probably possible to make a non-condensing power plant of good size which would not weigh more than forty or fifty pounds per horsepower. It might be composed of boilers of the express marine type which would weigh sixteen to twenty pounds per horsepower, including the weight of water, and of turbines which would weigh fifteen pounds per horsepower, and of the necessary auxiliaries.

The only possibility of obtaining light power plants is by the use of the internal-combustion engine. The Diesel engine with its high efficiency has not yet been brought down to a reasonable weight. In Europe, weights of 50 to 60 pounds per horsepower are reported. In this country the weights are usually four to six times greater. The automobile engine, including the radiator and jacket water, which are necessary parts of the power plant, will probably average about ten pounds per horsepower.

The aëronautical engine of the water-cooled type has been brought down to a total weight, including radiator and water, of approximately two and one-half pounds per horsepower. The air-cooled aëronautical engine should be, and is, much lighter. Varying reports about the A. B. C. English airplane engine indicate a weight per horsepower somewhere between 1.3 and 1.7 pounds. This seems to be the best figure so far.

Another improvement, however, looms in sight. The horsepower of an internal-combustion engine is directly proportional to the pressure of the mixture taken in. By the use of a centrifugal compressor (supercharger) the admission pressure can readily be doubled, thereby doubling the power of the engine. This device has been used at high altitudes for maintaining the power of an engine.

It could also be used on the ground for increase of power beyond the normal ground horsepower. Such a device would weigh not more than one-fourth the weight of the engine and would thereby increase the power per unit weight by 60 per cent, if its use did not necessitate such changes in the engine as to cause the weight of the engine to be increased.

It is certain that the attempt to double the intake pressure in any of the existing air-cooled aëronautical engines would lead to overheating of the piston and cylinder as a result of the increased weight of fuel burned, but modifications in design could take care of this increased heat. The way, then, seems open for those who desire to follow it. An editorial in a recent issue of Power, from which the above is taken, confidently asserts that: "It will not be very long before one pound per horsepower is a realized fact."

Notes of Industry

According to reports from the city of Warsaw, gold has been struck near the village of Miechgow in the Cracow region. A great deal of excitement has been caused by the announcement. Dispatches from an American Red Cross unit in that section confirm earlier rumors of the gold strike.

To prevent solder pots used by linemen upsetting, a Chicago man has invented a spiral hook for their handles, which can not slip off.

An official report recently made public by the British government states that the Germans made 32 air raids on London during the war; in one of which $7,000,000 damage was done. Zeppelins crossed the British coast more than 80 times.

According to New York *Sun-Herald*, H. G. Matthews, a British wireless telephone expert, announces successful experiments in photographing sound waves and electrically reproducing them. Mr. Matthews also says that he has obtained encouraging results in developing apparatus whereby sight of distant events is instantaneously transmitted.

The U. S. Shipping Board has reported that more than 500,000 dead weight tons of new ships were delivered to the Board by American shipyards during April. More than 2,000 vessels have been turned over to the Government.

That condition is regarded as of far reaching importance by Government economists, who are following closely the credit and trade situation of the nation. Shrinkage in bank deposits means an equivalent if not greater shrinkage in credit, which injects a new factor and a natural one into a situation that has been artificially influenced through the increased rediscount rates of the reserve banks.

The exact manner in which coal absorbs oxygen is not clearly understood. According to a Bureau of Mines bulletin, a solid substance can hold gases actually dissolved in its interior. With coal, the absorption of oxygen is complicated by the fact that, in

addition to this physical action, there is also a very complex chemical action. Part of the oxygen is converted into water, part into carbon dioxide, and part is retained as combined oxygen, producing compounds richer in oxygen than the coal itself. Part of the carbon dioxide is retained by the coal, for coal at ordinary temperatures has an enormous capacity for holding carbon dioxide.

The cost of bituminous and gas coal to the consumer according to reports from Baltimore reached the highest price in the history of the United States recently.

There is a gold mine in the Ouray county of Colorado which has built the whole of its plant, including everything from the crushing mill to the settling tanks, in underground chambers. The reason for this arrangement is the severity of the snow slides, which wreck all buildings above ground level.

A windmill grinds grain into flour and then mixes and kneads it into dough for a baker in a European country.

Heels made chiefly of coiled springs covered with flexible leather are a Kansas inventor's footwear novelty.

Roughened plates have been invented to be attached to a man's shoes to keep his feet from slipping on ladders.

The Lamson Company have occupied their new offices at 9-11 East 37th Street, New York. Telephone Vanderbilt 1754. E. E. L. Taylor is district manager.

In England efforts or experiments in the use of compressed gas for driving automobiles have not ceased with the war. It is found that coal gas compressed to thirteen atmospheres is thirteen times as bulky as gasoline of the same propelling value. This feature alone is held to limit the use of gas to a radius of action of only ten or twelve miles.

H. A. Matthews, Vice-President of the Irving National Bank, New York, recently stated that his opinion was that Spain offered the best opportunity to-day in Europe for the extension of American foreign trade.

The discovery of a large body of oil shale near Kimberly gold fields in Western Australia has been reported.

In 1919, exports from the United States continued large, despite the failure to work out a comprehensive plan for financing the Old World. But, according to analysis that have been made, of the $4,000,000,000 balance of trade against Europe, about $1,750,000,000 was taken care of out of United States Treasury advances, out of the $10,000,000,000 fund, which is now used up, approximately $250,000,000 through security operations, and about $2,000,000,000 through the extension of credit by firms, corporations and banks. Bankers are agreed that this same ratio cannot obtain in 1920 because the Treasury expects to make no more advances, and the reserve conditions of the banks and the Federal Reserve system are such that the banks, in the opinion of observers, cannot continue to load up with liquid obligations of Europe either directly or by aiding their customers who are in turn extending credits to Europe.

THE NEW KING

The New York Czechoslovak Chamber of Commerce announces that oil had been struck in three places in Slovakia.

The construction of a hydro-electric plant, larger than any now existing in the world, will become possible if Congress passes the water power leasing bill. In this event it is expected that the General Electric Company or one of its subsidiaries will get the lease of the Priest Rapid site on the Columbia River where there can be developed an hydraulic plant with a maximum capacity of 700,000 h. p. in high water, and 400,000 h. p. in low water. This will involve the construction of a dam 85 feet high across the Columbia River below which all the land may come under a gravity ditch.

J. J. Shean has been placed in charge of the Curry Department of the Graton & Knight Manufacturing Co. of Worcester, Mass., leather belting manufacturers.

In an article on "Submarine Acoustics" in *Nature*, Mr. F. Lloyd Hopwood concludes by saying that already hydrographic surveys of the North Sea are being carried out in which the position of danger spots is located for charting purposes by exploding depth charges and recording the resulting disturbances at a number of hydrophones connected to land stations. This method of submarine sound-ranging is by far the most accurate method of locating such spots, and also provides a means of enabling a ship at sea to obtain its correct bearings. By dropping a bomb hundreds of miles at sea, a ship can in a few minutes communicate its position to the nearest shore station and receive this information itself back again by wireless.

Norway is credited with the longest aerial power cable, which spans a stretch of water in one of the fiords. There are three cables with a span of 1,384 meters, nearly a mile; the cables are 40 meters above the water at their lowest point; in their crossing they drop 80 meters from the level line. In still weather the tension is four tons; when it blows it may be double this amount.

The hangar for rigid airships, which is being built at Lakehurst, N. J., will have the largest roof in America with a clear space beneath. The outside dimensions of the building will be 954 ft. by 350 ft. by 200 ft. high. Inside the measurements will be 803 ft. by 262 ft. by 172 ft. The roof is to be carried by a series of three hinged arches on the top of high triangular towers.

The Bethlehem Shipbuilding Corporation has filed notice of an increase in capital from $15,500,000 to $25,000,000.

Not far from Payson, in the Sierra Ancha Mountains, are the asbestos deposits that have made Arizona prominent as an asbestos producer. These are the Ash Creek asbestos mines, which were discovered in 1913, and which have been running ever since, with some of the largest asbestos companies in the world operating therein.

Latest U. S. Patents

JUNE 29

1,344,615. AIR-TEMPERATURE REGULATOR FOR GAS-ENGINES. Carl F. Brostrom, Minneapolis, Minn.

1,344,671. PROCESS FOR OBTAINING LIGHT HYDROCARBONS FROM HEAVY HYDROCARBONS. Friedrich Bergius, Hanover, Germany.

1. The process of obtaining light hydrocarbons from heavy hydrocarbons which comprises heating the heavy hydrocarbons in contact with and under a pressure of hydrogen exceeding 20 atmospheres.

1,344,883. PNEUMATIC PUMP. George W. Goss, Lubbock, Tex.

1,344,921. AIR-SUCTION REGULATOR. Henry Herman Meyer, Red Wing, Minn.

1,344,967. METHOD OF AND APPARATUS FOR COMPRESSING FLUID. Robert Suczek, Philadelphia, Pa.

1,344,988. BLOW-TORCH. Fred W. Clifford, San Francisco, Calif.

1,344,994. CONDENSER SYSTEM AND VACUUM-PUMP. Paul Diserens, Cincinnati, Ohio.

1,344,997. SHUTTER-ACTUATING APPARATUS. Hans B. Emmrick, Giddings, Tex.

1,345,022. AIR-MOTOR. Dew R. Oliver, San Francisco, Calif.

1,345,181. DOUBLE-HEADING AIR-BRAKE SYSTEM. Edgar R. Hewitt, Plattsburg, N. Y.

1. In a double heading brake system, the combination of a main reservoir on each locomotive, a train pipe and a tapping device interposed in the said train pipe and provided with means for controlling the passage of train pipe air pressure from the main reservoir of the first locomotive through the tapping device, the said tapping device having means connecting the main reservoir of the second locomotive with the train pipe by way of the tapping device, the said second means being controlled by the said first means.

1,345,270. ROCK-DRILL. William A. Smith, Denver, Colo.

1,345,271. DRILLING APPARATUS. William A. Smith, Easton, Pa.

JULY 6

1,345,388. VALVE FOR HIGH-PRESSURE-FLUID CONTAINERS. Rudolph J. J. Mueller, Sheboygan, Wis.

1,345,424. VACUUM CLEANING-BRUSH. Henry W. Wasenska, Collinsville, Ill.

1,345,478. VACUUM CLEANING APPARATUS. Elza T. S. Cliffe, Mansfield, Ohio.

1,345,495. PNEUMATIC TOOL. Michael D. Karles, Delray, Mich.

1,345,520. COMPRESSED-AIR-PIPE COUPLING. William O. Vivarattas, Weehawken, N. J.

1,345,550. PNEUMATIC CLEANER. Daniel B. Replogle, Berkeley, Calif.

1,345,674. ELASTIC-FLUID TURBINE. Francis Hodgkinson, Edgewood Park, Pa.

1,345,681. AIR-WASHER. Edwin J. Kratochvil, Bancroft, Nebr.

1,345,870. FLUID-PRESSURE-MEASURING INSTRUMENT. Robert John Nash and George Henry Alexander, Birmingham, England.

1,345,884. UNLOADER FOR COMPRESSORS OR THE LIKE. Edward A. Rix, Oakland, Calif.

1,345,955. ROTARY ENGINE, COMPRESSOR, AND EXHAUSTER. William Reavell and Hans Haerle, Ipswich, England.

1,345,973. AIR-COMPRESSOR. Burchard D. Thompson, Cyclone, Pa.

1,345,994. PNEUMATIC-TIRE CASING AND PROCESS FOR MAKING SAME. Fred B. Carlisle, Andover, Mass.

1,346,015. AIR-SEPARATOR. William A. Gibson and Charles E. Needham, Allentown, Pa.

1,346,042. PNEUMATIC-DESPATCH-TUBE APPARATUS. James G. Maclaren, Harrison, N. Y.

1,346,044. BLOWER AND SUCTION CARPET AND RUG CLEANER. Frank P. Moore, St. Joseph, Mo.

JULY 13

1,346,126. APPARATUS FOR PIERCING TIMBER. Paul J. Howe, Ridgewood, N. J.

1,346,144. PNEUMATIC CONVEYER. Louis C. Vanderlip, Elkhart, Ind.

1,346,166. PNEUMATIC HAMMER. Jakob Bernhard, Hasle, near Ruegsau, and Arthur Meister, Ruegsau, Switzerland.

1,346,246. PNEUMATIC PIANO-PLAYER. Claus E. Peterson, Worcester, Mass.

1,346,282. COTTON-PICKING MACHINE. Joseph B. Tibbs, Tibbs, Miss.

1,346,284. TIRE-PUMP. Peter Wajdic, Pleasant Unity, Pa.

1,346,293. FEED-DRUM FOR PNEUMATIC ELEVATORS. George Bernert and Jacob Bernert, Milwaukee, Wis.

1,346,341. PERCUSSION-TOOL. Albert Schinkez, Grand Haven, Mich.

1,346,404. OSCILLATING-TYPE COMPRESSOR. Charles D. Havenstrite, Chicago, Ill.

1,346,408. HIGH-VACUUM PUMPING SYSTEM. William V. Lovell, Wilkinsburg, Pa.

1,346,482. VACUUM FEED MECHANISM. Clifford C. Bradbury, Oak Park, Ill.

1,346,699. AIR-COMPRESSOR PUMP. George Burd and Charles Burd, Detroit, Mich.

1,346,796. BLOWER. Rudolf Rosner, Chicago, Ill.

Recent British Patents

Abstracted for COMPRESSED AIR MAGAZINE By Messrs. John E. Raworth & Moss, London

142,534. POWDER DISTRIBUTOR. H. Maxwell-Lefroy and P. E. Cheesman of London.

142,591. STUFFING BOX. W. L. Rowe, G. W. Wright and G. H. Bullick of London.

142,725. DEVICE FOR INDICATING THE PASSAGE OF A FLUID. L. LeBozec of Asnieres, France.

PRACTICAL USE OF THE SAND BLAST

IN SAND blasting, the higher the air velocity, the greater the effectiveness of the abrasive. Other things being equal, the smaller the aperature through which the compressed air and abrasive is forced, the higher the velocity when the abrasive hits the object. These are among points brought out in a comprehensive description of methods and equipment of sand blasting contained in the *Iron Age*:

"While the travel of compressed air through a pipe or hose is approximately the same at all pressures above one atmosphere, the velocity of the abrasive after leaving the nozzle increases very rapidly as the air pressure is increased, with correspondingly greater blasting effectiveness. This permitted the use of small, easier handled hose and small nozzle, in place of the large, cumbersome hose and nozzle, with a very decided saving in labor to the tonnage cleaned. Better operating conditions were obtained also through reduction of dust created by disintegration from the lesser volume of sand used. Some better understanding of this will be possible from the results of tests made. These show that the amount of sand blown at 30-lb. pressure to remove 1 lb. of metal from an iron bar was 3361 lbs., while at 70-lb, pressure the required sand was but 2043 lbs., or over 50 per cent more at the lower pressure, the same size nozzles being used in both instances. Of the reusable sand there is only 17.2 per cent difference in favor of the lower pressure.

"The amount of metal removed per 100 cu. ft. free air per min. flowing was, at 30-lb. pressure, 0.1969 in., and at 70 lbs., 0.4473 in., or nearly two and one-half times as much accomplished at the higher pressure with no increase in time and labor.

"Constant wear, varying with pressure and abrasive, is occasioned in the nozzle, as shown above, and a very little enlargement means considerable increase of air consumed and horsepower as well. For instance, a nozzle with ¼-in. opening flows 76 cu. ft. of free air per min. at 70 lb. pressure, as in the sand tests above, requiring 12.7 hp. to develop. Increase this opening 1-32 in., and the air flow increases to 85.5 ft., or 12.5 per cent. and horsepower requirement is 14.3. An enlargement of 1-16 in. increases the air flow to 118 cu. ft., or 16.5 per cent, with horsepower developed 19.9. And if the increase reaches ⅛ in. the air flow jumps to 171 cu. ft., or an increase of 125 per cent, while the horsepower developed rises to 28.6. If this wear, therefore, can be eliminated, obviously much power expense will be saved as well as constant pressure maintained.

"The construction of the modern sand blast room is sheet steel made dust-tight, with fresh air inlets around the sides near the base, the dust-laden air being carried off through a hood in the ceiling of the room by an exhaust fan.

"The volume of dust created will be governed by the character of work cleaned, that is, whether plain surfaces to which little sand adheres, or intricate shaped pieces from which cores must be blasted; also whether sand or metal abrasive is used, and if sand its friability.

"The room can be equipped as the demands of the plant and its output require. Large, heavy castings should be loaded at the molding floor on to grated top cars, the track extending into the sand blast room and the pieces cleaned on the car without unloading. If the plant is equipped with a monorail, this, too, can be extended into the room and the pieces cleaned while hanging without other handling. For small work a grated top bench can be provided where convenient, and for very small pieces much economy will be found in cleaning on the grates, it having the advantage of saving on tools and giving, without extra time and cost, clean scrap which is particularly advantageous and even necessary in the use of some types of electric furnace.

"The trend toward hygienic rooms that entirely remove the operator from the sand blast inclosure has developed devices of different types that meet every demand.

"With the progress in sand blast equipment and methods has come also progress in the matter of abrasives. Undoubtedly the white silica sands where available are most desirable. In fact, by their hardness and uniformity they would undoubtedly prove most economical at a considerably higher first cost.

"Metal abrasives in the form of chilled shot, rrushed steel, etc., are produced by different manufacturers, each making claims for their superiority. Of the life of the metal abrasives over sand there can be no question and this will range from 20 to 60 times."

Index to Advertisers

Anaconda Copper Mining Co.	10
Books for Compressed Air Workers	9776
Bury Compressor Co.	11
Cameron Steam Pump Works, A. S.	8–17
Cement Gun Company	14
Chicago Pneumatic Tool Co.	23
Compressed Air Data	15
Compressed Air Magazine	24
Cooper Co., C. & G.	21
Goodrich Rubber Co., B. F.	3
Griscom-Russell Co.	9
International High Speed Steel Co.	4
Ingersoll-Rand Co.	6–7–20
Jarecki Mfg. Co.	22
Jewett Machinery Illustrators	15
Keystone Lubricating Co.	5
Lake Superior Loader Co.	13
Lidgerwood Mfg. Co.	12
McCord Manufacturing Co.	19
National Safety Council	18
New Jersey Meter Co.	2
Noble Co., The K. B.	22
Oldham & Sons Co., Geo.	15
Pangborn Corporation	16
Perfection Washer	18
Powell Co., The Wm.	19
Republic Rubber Co.	12
Scaife & Sons Co., Wm. B.	22
Sprague Electric Works	16
Stearns-Roger Mfg. Co.	2
Victory Equipment Corp.	16
Yarnall-Waring Co.	15

Announcement of Technical Books

COMPRESSED AIR DATA, by William Lawrence Saunders and Charles Austin Hirschberg.

Price, Domestic, $3.00 Net, Postage Paid.

COMPRESSED AIR PRACTICE, by Frank Richards, Technical Editor of Compressed Air Magazine.

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COMPRESSED AIR FOR THE METAL WORKER, by Charles Austin Hirschberg.

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